for

engineers and contractors controlling the design, specification, installation and maintenance of heating, ventilating and air conditioning.

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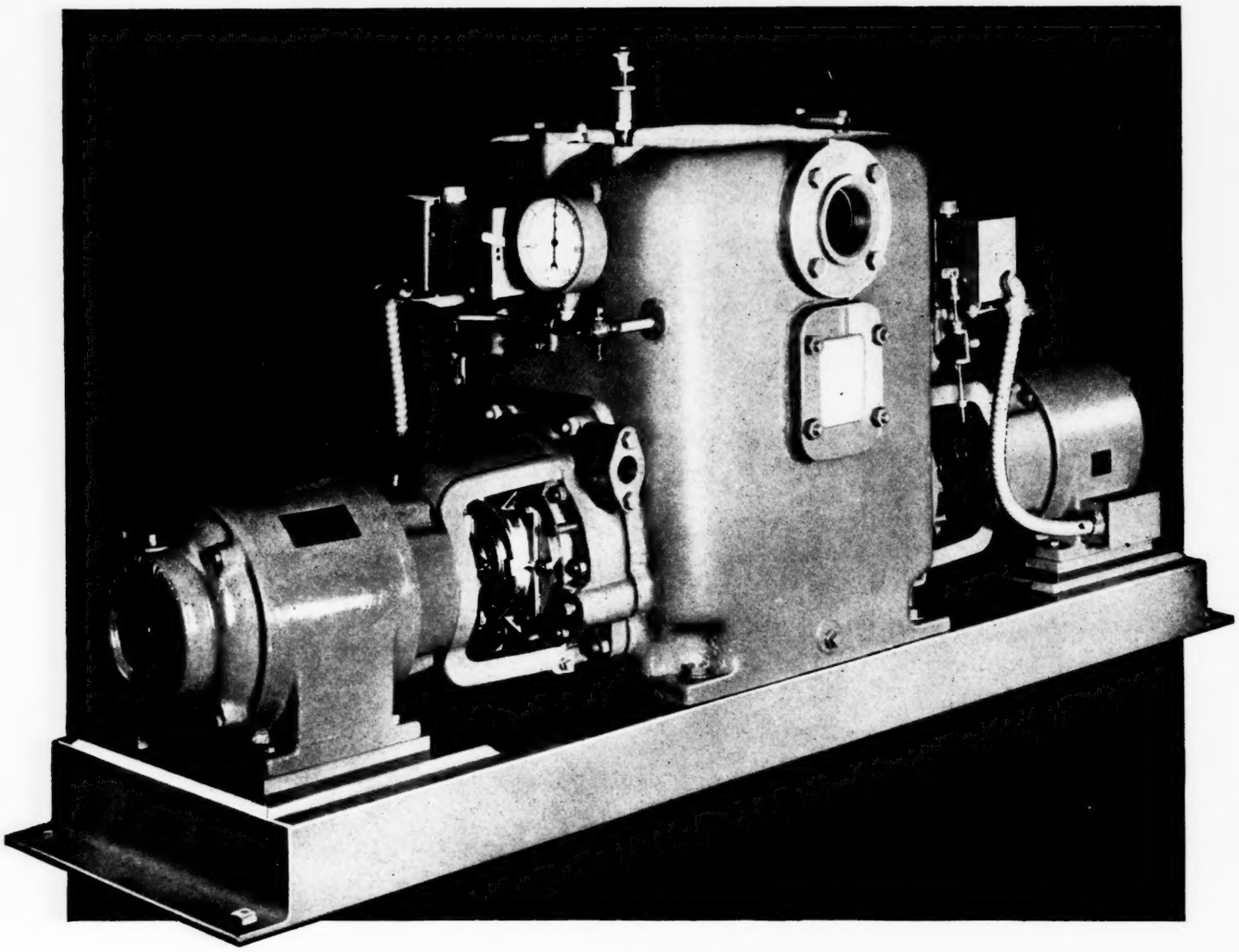

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Fig. 1. Air view of the campus of the University of Minnesota, Minneapolis, Minn.

Deep Tunnel Heating at the University of Minnesota

By MILTON FIGEN

A DECREASE of more than 50% in the cost of heating per cubic foot of building between 1919 and 1939 is shown in a study, just completed, of the deep tunnel heating system of the University of Minnesota. This saving results from improvements and additions to plant equipment and other important heat saving measures instituted over the above period.

The tunnel system serves the university's main campus on which are located 55 buildings with an aggregate capacity of 72 million cubic feet. This is between three and four times the load carried by the plant since its establishment in 1912.

Minnesota today is the largest university in the nation in number of students. The main campus heating system is believed to be the largest university plant in the nation.

The 55 buildings vary in size from an astronomical observatory of 16,850 cubic feet to an enormous field house of 9,250,000 cubic feet. Other buildings include libraries, classroom halls, laboratories, greenhouses, gymnasia, storage buildings, museums, dormitories, hospital, university union, auditoriums, and a stadium, of which 4,500,000 cubic feet constitute the *interior* which houses handball courts and office space and which must be heated.

The university has numerous other buildings, most of them located on the farm campus several miles from the main campus, which are separately heated.

The main campus buildings are not grouped closely but spread, instead, over an area totalling 137 acres. They are fed through a system of close to 18,000 feet of tunnels carrying steam mains, returns and auxiliary lines from the central plant situated on one edge of the campus on the bank of the Mississippi River below the campus level.

Appproximately 10,000 feet of this tunneling are at a depth of 100 feet below the campus level. Remainder of the tunnels are of the surface type, feeding off the deep tunnels.

The location of the heating plant is excellent from several points of view. It allows for gravity flow of coal, eliminates any coal dust nuisance on the campus, and allows for good drainage of return lines.

Nearly all condensate is returned to the plant. In the winter makeup water amounts to 5%; in the summer, 30%.

Steam is fed at 120 lb pressure and is reduced at buildings to approximately 5 lb for direct rediation, in use in the majority of the buildings. Quality of the steam is 99%.

The heating plant supplies only a heating load—no electric power. Steam produced in the last fiscal year (1938-39) covered by the study totalled 492,371,000 lb, while the maximum daily steam output was 3,500,000

TABLE 1.

RELATIVE LOAD INCREASE AT THE UNIVERSITY OF MINNESOTA DEEP TUNNEL PLANT
(1919-20 TAKEN AS BASE YEAR WITH VALUE OF 100)

	'19-20	'26-27	'32-33	'38-39
1. Gross cubic content of buildings	100	161	274	316
2. Connected equivalent dir. radiation used, sq ft	100	170	198	207
3. Tons of coal consumed	100	138	181	170
4. Number of students	100	151	175	228
5. Pounds of steam	100	162	206	202
6. Cost fuel and handling	100	140	136	139
7. Cost payroll and supplies	100	157	176	230
8. Total cost of operation	100	143	143	155

Actual figures for 1919-20 were: (1) 20,824,530 cu ft; (2) 240,000 sq ft; (3) 16,202 tons; (4) 7,551 students; (5) 243,420,000 lbs of steam; (6) $90,348; (7) $17,403; and (8) $107,751.

TABLE 2.—UNIT DATA FROM THE POWER PLANT

ECONOMY OF OPERATION AT THE UNIVERSITY PLANT
(1919-20 TAKEN AS BASE YEAR WITH VALUE OF 100)

	'19-20	'26-27	'32-33	'38-39
1. Cu ft of bldg. per sq ft of EDR in service	100	116	138	120
2. Tons of coal per 1000 sq ft—heating season	100	88	89	65
3. Btu per 1000 sq ft EDR in service—heating season	100	96	85	64
4. Lb of steam per lb of coal	100	118	112*	120
5. Lb of steam per sq ft EDR in service—heating season	100	105	100	60
6. Over-all efficiency of plant	100	108	113	116

Actual figures for 1919-20 were: (1) 86.76 cu ft; (2) 63.69 tons; (3) 1,539,569,500 Btu; (4) 7.42 lbs; (5) 948 lbs; and (6) 62.2%.

*Lower value is due to lowered Btu content of coal used during this year.

TABLE 3.—HEATING SYSTEM DATA

(1919-20 TAKEN AS BASE YEAR WITH VALUE OF 100)

	'19-20	'26-27	'32-33	'38-39
1. Total cost per 1000 cubic feet of bldg.	100	83	52	49
2. Total cost per sq ft equiv. radiation used	100	96	72	58
3. Total cost per 1000 lb. of steam	100	87	69	76
4. Coal cost per sq ft equiv. radiation used	100	94	69	53
5. Coal cost per 1000 lb steam—heating season	100	86	70	72
6. Coal cost per million Btu	100	94	81	84
7. Average cost per ton coal F.O.B. plant	100	102	78	85
8. Cost of heating per student	100	89	81	67

Actual figures for the base year are as follows: (1) $5.16; (2) $0.449; (3) $0.443; (4) $0.376; (5) $0.356; (6) $0.221; (7) $5.35; (8) $14.27.

lb. Cost of producing steam was 33.7 cents per thousand lb.

The maximum steam output for any year since establishment of the plant was in 1935-36. During that year a total of 565,902 lb of steam were produced.

Total consumption of coal in the year 1938-39 was 27,552 tons. The maximum consumption of coal on any single day was 177.4 tons with a mean temperature of —12F and a low of —22F. Each pound of coal produced 8.94 lb of steam. Total cost of heating each thousand cubic feet of building was $2.51 for the entire year. The overall efficiency of the plant was 72.6%.

Boilers

When the plant was built in 1912, eight boilers with an aggregate of 1800 hp were installed. These consisted of four 350 hp B & W two-drum boilers fired with chain grate stokers; two 350 hp boilers of the same kind fired with chain grate stokers later changed to individual hammer-type pulverizers; and two 350 hp Keeler boilers fired with chain grate stokers. The latter two boilers were removed in 1937. The remainder are still in use. They are connected to a common header, and all have natural draft. Efficiency is about 65%. The chain grates are driven by a single steam engine through a line shaft.

In 1927 two 750 hp Heine boilers (Nos. 9 and 10) with (Harrington) forced draft chain grate stokers were installed. They have a common forced draft fan and an efficiency of about 75%. Each chain grate has an individual steam engine drive.

In 1930 a 750 hp three-drum bent tube boiler, fired by a pulverizer, was installed. This unit, which generates 60,000 lb of steam per hour, had an efficiency of 80.7% at its acceptance test. Maintenance of this unit has proven excessive. Continuity of service was impaired as the equipment aged.

The newest unit in the plant was installed in 1936. It is a Riley four-drum bent tube boiler (No. 12) fired by two impact and attrition type pulverizers. Designed for 1900F furnace temperature, this unit has full water walls, except for the lower half of the front wall. Insulation is of magnesia and insulating brick. The outside is steel cased. It has a rating of 100,000 lb of steam per hour, with a maximum of 125,000 lb. It has all modern heat recovery apparatus, including force draft and induced draft fans and air heater. The boiler was especially built for low grade fuel consumption.

TABLE 4.—BASIC HEATING DATA, UNIVERSITY OF MINNESOTA

HEATING SEASON	TOTAL GROSS CUBICAL CONTENTS OF BLDGS.	TOTAL CONNECTED EQUIVALENT RADIATION	TOTAL CONNECTED EQUIVALENT RADIATION USED	TOTAL CONNECTED DIRECT RADIATION	CU FT OF BLDG. PER SQ FT EQUIV. RAD. USED	TOTAL NUMBER OF STUDENTS IN ATTENDANCE	TONS OF COAL USED PER HEATING SEASON	TONS OF COAL USED PER YEAR
1919-20	20,824,530	285,000	240,000	201,000	86.76	7,551	15,285	16,202
1920-21	21,243,957	285,000	255,000	201,000	83.31	8,100	12,661	13,564
1921-22	22,134,342	286,000	265,000	202,000	83.52	8,131	14,333	15,285
1922-23	23,868,636	307,000	293,000	211,000	81.46	8,961	16,606	18,372
1923-24	23,742,829	364,372	325,000	226,540	73.05	9,236	19,320	21,183
1924-25	33,166,534	416,588	332,062	258,116	99.88	9,858	18,214	19,895
1925-26	35,331,546	457,933	348,574	278,665	101.36	10,665	19,861	21,426
1926-27	36,059,819	465,891	358,360	296,227	100.62	11,415	20,327	22,272
1927-28	47,784,728	548,816	390,807	310,002	122.27	11,688	20,072	21,712
1928-29	47,784,728	576,499	418,490	333,685	114.18	13,146	21,774	23,325
1929-30	55,016,881	576,499	418,490	333,685	131.46	13,419	22,070	23,747
1930-31	55,031,241	604,439	446,865	362,407	123.15	13,864	19,905	22,020
1931-32	57,068,132	618,289	460,715	374,857	123.87	13,992	20,761	22,884
1932-33	57,068,132	633,364	475,790	386,496	119.94	13,225	27,139	29,377
1933-34	58,099,812	645,032	487,458	398,164	119.19	13,075	25,251	28,009
1934-35	60,975,751	681,997	524,423	418,100	116.27	14,022	26,290	29,440
1935-36	61,035,793	712,169	554,595	428,928	110.05	15,328	28,778	31,518
1936-37	63,039,943	742,076	584,502	436,674	107.85	16,277	27,024	29,514
1937-38	65,918,461	789,072	631,498	469,319	104.38	16,634	26,635	29,546
1938-39	65,918,461	789,072	631,498	469,319	104.38	17,250	24,223	27,553

*Figures for 1927 to 1935 from HEATING AND VENTILATING's record.

On one burner this unit can produce as low as 20,000 lb of steam per hour continuously. It is designed for 300 lb pressure with provision for a super heater. One of the drums is a steam drum which gives 11F superheat to the steam.

At its acceptance test at 100,000 lb of steam per hour, this unit gave an efficiency of 84.7%; at 30,000 lb an hour, of 86%.

Draft is supplied by turbine-driven forced and induced draft fans. Air is preheated by the air heater which recovers heat from stack gases. Under average conditions stack gases enter at 500F and leave at 420F. Air enters the pre-heater at room temperature and leaves at 350F.

The use of pulverizers has proven an effective economy by eliminating the necessity of banking, according to L. L. Wood, mechanical engineer in charge of heating at the university. He added that the rather large fluctuations in load due to shutting off of buildings at night made it desirable to have the flexibility provided by pulverizing units.

One of the unique features of No. 12 is the huge master control panel, from which the entire operation of the boiler and pulverizers can be controlled automatically or by hand. The panel has the following control instruments: Steam pressure indicating gauge; feedwater pressure indicating gauge; steam flow indicating gauge; steam flow and air flow recording gauge; draft indicator showing pressures at 10 points; indicated and recorded temperature of feedwater and steam; indicated and recorded temperature of air entering and leaving and gas entering and leaving preheater; indicator showing steam load on entire plant; indicator showing capacity being developed by force draft fan; indicators (two) showing oil pressure on both pulverizers; indicator showing amount of fuel being fed, and recording and indicating CO_2 gauge.

No. 12 boiler is used for the base heating load during the heating season and is run continuously from September to May. During off-peak loads last winter all other boilers were cut off bank. The continuity of service afforded by No. 12, along with its increased efficiency, helped considerably to reduce heating costs.

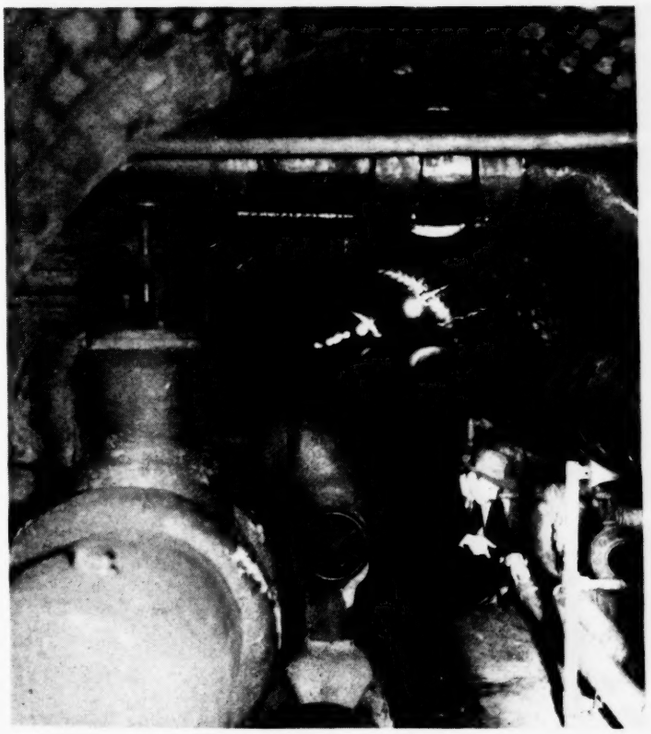


Fig. 2. Inside one of the deep tunnels in the University of Minnesota.

Up until March 27, 1940, the unit had been in operation a total of 431 days during which time it burned 39,000 tons of coal. The everyday operating efficiency of the unit is about 82% and that of the combination of other boilers which would equal the capacity of this unit, about 75%. Taking into account the differential in efficiencies, he calculated that the new unit realized a saving of 3600 tons of coal during the time it was used. Based on average coal prices over that period, this made a saving of $16,200 in fuel alone.

Exhaust Steam

Practically all auxiliaries at the plant are steam driven, and, with the installation of No. 12 in 1936,

TABLE 4.—Continued)

Average Cost per Ton of Coal	Total Cost of Fuel and Handling	Total Cost of Payroll and Supplies	Total Cost of Operation	Average Heat Value of Coal Btu per Lb	Mean Temperature During Heating Season, F	Wind Movement in Heating Season, Miles	Coal Cost per Million Btu	Degree Days During Heating Season 9/1-5/31*
$5.35	$90,348.23	$17,403.53	$107,751.76	12,088	32.9	73,609	$0.221	—
6.23	87,416.82	23,392.53	110,809.35	12,140	40.8	74,444	0.256	—
6.48	95,204.11	22,957.01	118,161.12	13,740	36.3	72,867	0.276	—
6.06	113,942.56	24,902.06	138,844.62	11,626	36.6	75,923	0.261	—
5.10	107,200.50	25,297.50	132,498.00	11,754	36.8	73,326	0.217	—
4.97	108,926.62	27,086.12	136,012.74	11,847	37.7	73,270	0.210	—
4.87	105,649.26	26,756.17	132,405.43	12,747	34.3	73,703	0.191	—
5.47	126,962.10	27,460.67	154,422.77	13,165	34.1	76,117	0.208	—
5.64	123,227.53	29,324.95	152,552.48	13,229	34.1	69,119	0.213	8,162
5.01	117,205.05	29,520.08	146,725.13	13,189	35.1	63,914	0.190	8,139
4.54	127,797.12	31,519.56	159,316.68	12,920	36.6	70,426	0.176	7,877
5.00	111,648.60	28,455.24	140,403.84	13,187	39.3	64,000	0.190	6,803
4.44	101,423.75	29,555.15	130,978.80	13,134	38.1	66,493	0.169	6,944
4.21	123,678.43	30,735.87	154,414.30	11,741	34.9	72,167	0.179	7,879
4.24	118,759.60	32,691.07	151,450.67	12,227	36.8	74,004	0.173	7,604
4.58	134,834.97	26,686.50	161,521.47	12,318	36.0	70,629	0.186	7,725
4.59	144,823.96	30,437.74	174,761.70	12,436	31.0	67,650	0.185	8,962
4.37	127,402.22	32,189.15	159,591.37	12,780	35.1	78,399	0.171	8,314
4.39	129,704.75	36,373.38	166,078.13	12,220	37.4	70,726	0.180	7,701
4.57	125,914.93	40,018.48	165,933.41	12,540	35.6	69,264	0.182	7,714

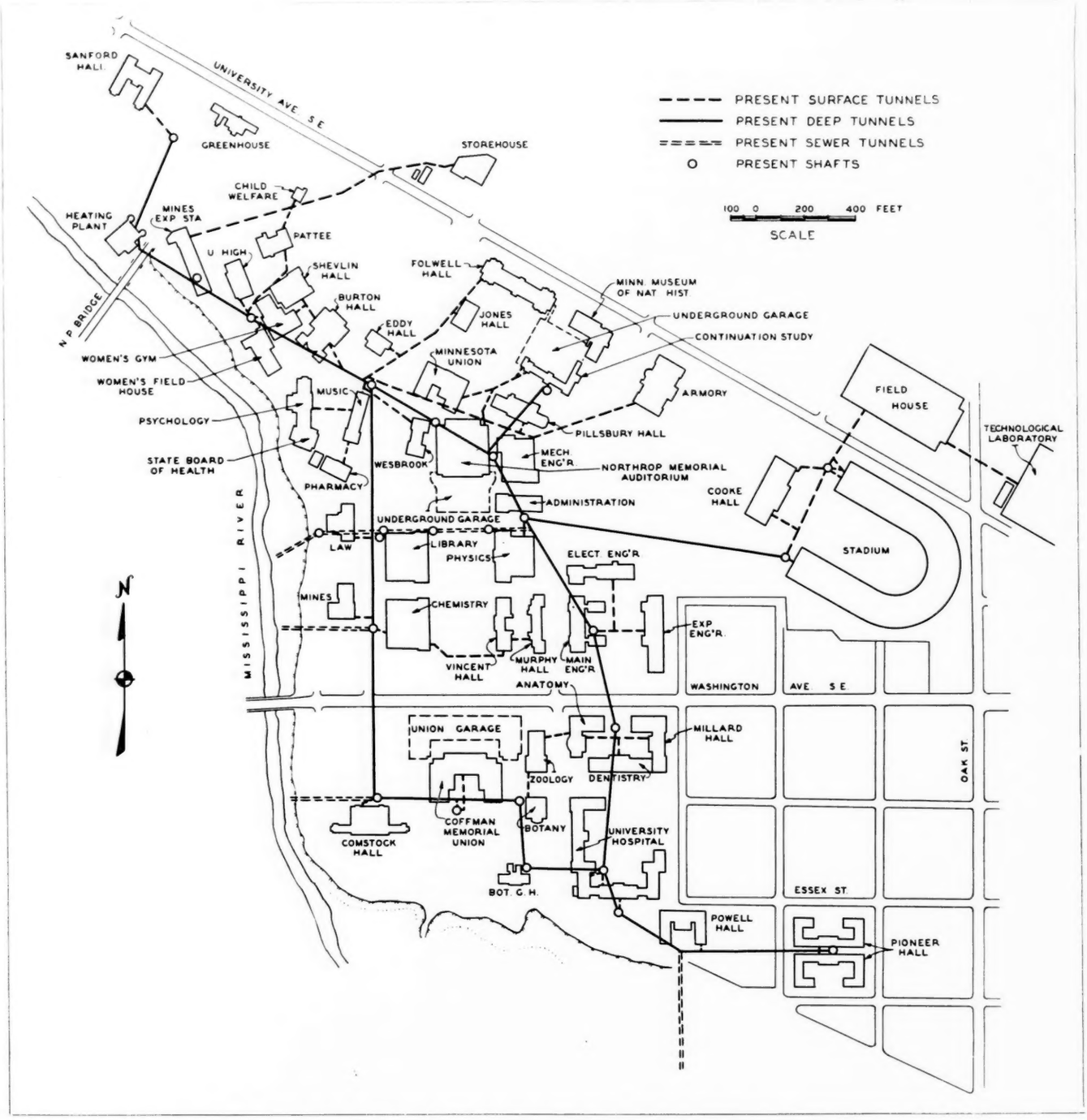


Fig. 3. Plan of the University of Minnesota's campus showing location of pipe tunnels.

more exhaust steam was available than could be used in heating feedwater. To save this steam, which otherwise would be discharged to the atmosphere, the summer steam distribution system (12 in. line) was given over to exhaust steam for heating some of the buildings. Today 10 buildings with a total capacity of 17,150,000 cubic feet are on exhaust steam, including the journalism building completed in the current fiscal year. One hundred per cent of exhaust steam is now being utilized.

Distribution and Utilization

Eight separate lines are carried in the deep tunnels leading from the heating plant. These lines are stepped down in capacity as different branches are taken off. At source the lines and their respective capacities are as follows:

A 14 in. high pressure line for winter heating; a 12 in. line for summer use and exhaust steam winter use; an 8 in. condensate return line; a 1 in. air line; a 1 in. water line; a 4 in. cold water line; a 4 in. vacuum line; and a 4 in. bleeder line.

Loss of heat through radiation in the tunnels is negligible because the tunnels are not vented to the out-of-doors. The air from the tunnels, drawn back by suction of the heating plant, is used for combustion.

Lowered fuel consumption in the past four years is partially the result of a Webster Moderator remote temperature control system installed in the plant. A number of buildings, with an aggregate cubic capacity

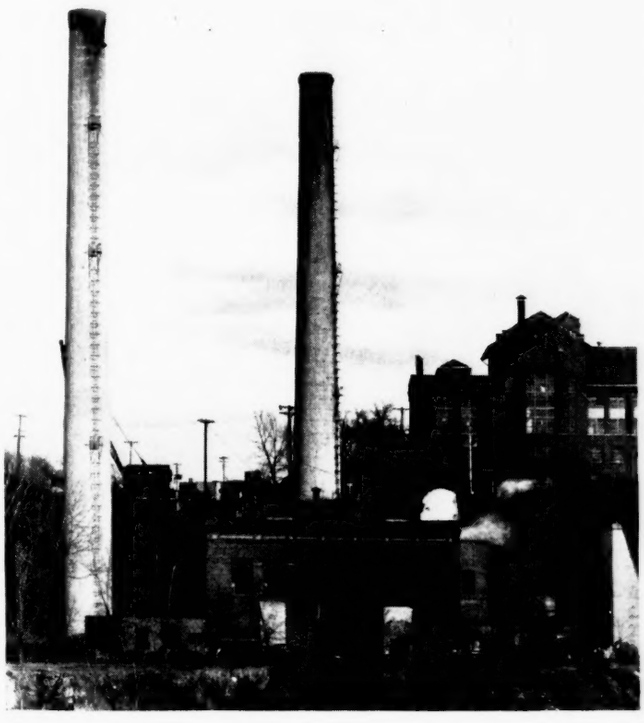
TABLE 5.—UNIT HEATING DATA, UNIVERSITY OF MINNESOTA

Heating Season	Cost of Heating per Student	Coal Cost per Sq Ft Equivalent Radiation Used	Total Cost per Sq Ft Equivalent Radiation Used	Tons of Coal per Thousand Sq Ft Radiation, Heating Season	Thousand Btu per Thousand Sq Ft Radiation, Heating Season	Thousand Pounds of Steam Used per Heating Season	Pounds of Steam per Pound of Coal	Coal Cost per Thousand Lb of Steam	Total Cost per Thousand Lb of Steam	Pounds of Steam per Sq Ft of Radiation	Overall Efficiency of Plant, Percent
1919-20	$14.27	$0.376	$0.449	63.69	1,539,570	227,740	7.42	$0.356	$0.443	948	62.2
1920-21	13.68	0.343	0.434	49.65	1,205,571	175,396	6.92	0.443	0.580	688	57.8
1921-22	14.53	0.359	0.446	54.09	1,269,997	237,454	8.28	0.384	0.460	896	60.9
1922-23	15.49	0.389	0.474	56.60	1,316,063	221,533	6.66	0.462	0.573	756	56.2
1923-24	14.33	0.330	0.408	59.44	1,397,460	286,207	7.41	0.348	0.424	880	62.4
1924-25	13.80	0.328	0.410	54.85	1,299,616	249,356	6.85	0.365	0.503	752	57.4
1925-26	12.42	0.303	0.380	56.98	1,452,648	312,491	7.86	0.301	0.382	898	63.2
1926-27	13.53	0.354	0.431	56.72	1,493,438	359,050	8.82	0.308	0.390	1,002	67.3
1927-28	13.05	0.316	0.390	51.36	1,358,883	361,731	9.00	0.313	0.391	925	67.7
1928-29	11.16	0.280	0.351	52.15	1,370,800	370,686	8.63	0.288	0.361	887	66.1
1929-30	11.87	0.286	0.356	49.39	1,276,210	**354,213**	8.53	0.266	0.393	844	66.4
1930-31	10.13	0.251	0.312	44.65	1,178,000	304,089	9.15	0.273	0.335	816	69.4
1931-32	9.36	0.221	0.284	45.06	1,183,636	386,377	9.30	0.238	0.306	838	70.6
1932-33	11.68	0.260	0.325	57.04	1,339,398	453,291	8.35	0.252	0.307	953	71.1
1933-34	11.58	0.244	0.311	51.80	1,266,757	441,353	8.74	0.269	0.308	905	71.3
1934-35	11.52	0.257	0.308	50.20	1,236,727	485,459	9.23	0.278	0.298	926	74.4
1935-36	11.40	0.261	0.315	51.89	1,290,600	515,944	8.98	0.266	0.309	930	74.5
1936-37	9.80	0.218	0.273	46.23	1,181,639	471,042	9.15	0.251	0.296	806	72.9
1937-38	9.98	0.205	0.263	42.18	1,030,825	458,034	8.99	0.255	0.313	725	74.7
1938-39	9.62	0.199	0.263	38.40	902,068	429,014	8.94	0.258	0.337	679	72.6

of 15,030,000 feet, have been placed under this system, two of them in the current year.

Essentially the system establishes control in the plant of the amount of time radiation is on, and correlates it with outside temperature through a thermostat located on the roof of the plant. The equipment consists of a cylindrical cam rotated at constant speed with contact makers riding on the cam. When the raised surface strikes the contact maker, an electric circuit is made which causes a motorized valve to open in the steam line in the tunnel. The system is of the *off and on* type due to the constant speed of the cam. The outside thermostat causes the contact maker to shift position horizontally along the cam and vary the length of the *on* time.

A hot process lime and soda softener softens all make-up water used. The make-up, as previously pointed out, varies from 5% in winter to 30% in summer. Chemicals are dumped into a mixing tank. Raw water is drawn through a water meter geared to a pulley which lets a decanting pipe into the solution. The solution runs through the pipe to a pump which carries it to a 12,000-gallon reaction tank in proportion to the amount of water coming in. Raw water, after passing through the meter, goes to the reaction tank which is heated by 5 lb steam exhaust to about 200F. Sludge is blown off the bottom of the tank once a day. Clear softened water is taken off the top of the tank and passes through two coke bed filters and thence to the condensate storage tank.



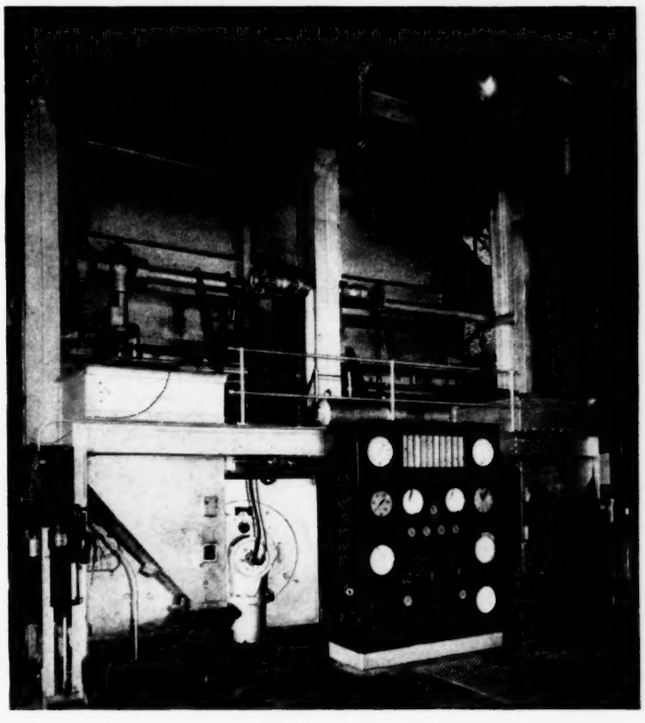


Fig. 4 (Left). University of Minnesota's heating plant. Fig. 5 (Right). A view inside of the power plant showing the main instrument board and the Riley boiler which has a capacity of 100,000 lb of steam per hr.

City water contains about 12 grains per gallon of hardness in terms of $CaCO_3$ in winter, and about seven or eight grains in summer. The softened water contains about one grain.

Feedwater System

Condensate return lines from the campus are fed into an 8000-gallon reservoir. Three vacuum pumps maintain 5 to 10 inches of mercury vacuum on the return line at the pump. From the reservoir it goes to an open type feed-water heater, then through a V-notch weir with integrator, and then to the pump suction.

There are three centrifugal type feedwater pumps of 500 gpm capacity each, any one of which will carry the load. A fourth centrifugal pump has been reconditioned for summer operation and test work. The discharge water pressure is 150 lb. The pumps are directly connected to steam turbines.

A duplicate set of feedwater pipes is planned. This will permit repairs without shutdown and also provide for isolation of boilers during tests. The present lines were replaced this year.

Coal

Until seven years ago the type of fuel used was West Virginia splint coal running over 13,000 Btu per lb. The coal burned since then has been Indiana and Illinois 1½ in. washed screenings running around 12,000 Btu per lb. By making certain changes in equipment it was found that the boilers would burn this poorer grade of fuel with as good efficiency as the better grade. These changes consisted, in the main, of adding more links to the width of chain grates to compensate for lower grate temperatures arising from higher ash content of the fuel. It proved necessary to carry slightly lower ratings in the boilers to prevent ash fusion. Also, tempering of the cheaper grade of fuel with exhaust steam while in the hoppers proved beneficial.

Coal is delivered in dump-bottom railroad cars and dropped into a hopper where a horizontal belt conveyor delivers it to the bunkers located over the boiler room floor. The bunkers have a storage capacity of 800 tons. The coal drops from the bunkers by gravity into a coal weigh larry equipped with coal scale, and from there it falls to the hoppers. The boilers are arranged in two rows, with the bunkers above in a single row between the boiler rows.

Ashes are removed from Nos. 11 and 12 by steam velocity jets located in an extra strong pipe which carries the fly ash to the ash pile on the bank of the river. Ashes from the other boilers are removed by ash cart and elevators from the basement.

General

Boilers 1, 2 and 11 are provided with electric motor drives on the pulverizers to permit starting plant if steam is down. These are in addition to the steam turbine drives. Since no electric drives are provided on the feedwater pumps, raw water under city pressure is used until steam pressure of about 30 lb is developed.

The operation crew consists of a chief engineer, three first firemen, three second firemen, one substitute fireman, one brick layer and pipe coverer, one crane operator, one welder and machinist, three steam fitters and welders, and three laborers.

Present plans call for the installation of another 100,000 lb unit within the next few years.

While figures for the last fiscal year (1939-40) were not included in the study, it is not expected that they would show any deflection in the curve of improving economy of operation.

Greater economy is anticipated through improved operating methods, keeping of each boiler in service as long as possible while it is being used, cutting out of boilers on bank, and operation of boilers closer to their most efficient points. Also it is expected that savings should accrue from extensions which have been planned of the number of buildings on exhaust steam and from the remote temperature control system.

The Weather Really is Warmer

The weather really was colder back in the Eighteen Thirties and Forties, continuous records running back for a hundred years indicate. A study by Weather Bureau scientists of records from four widely separated stations (Minneapolis-St. Paul, St. Louis, Boston and Washington) indicates quite strongly that since the Eighteen Thirties the climate has been warming up.

During the first third of the century from 1840 to 1939 temperatures at all four stations were prevailingly low. In the past two decades there has been persistent abnormal warmth.

"In comparing what may be considered warm and cold years, that is, those showing departures of 1 degree or more from the 100-year average," says the Weather Bureau's report, "it may be noted that for the first half of the record St. Paul had 9 warm and 26 cold years; St. Louis, 9 and 17; Washington, 4 and 15, and Boston, 4 and 30, against a reversal to 23 and 8, 21 and 9, 19 and 8, 27 and 3, respectively, for the warm and cold years for the first half, and 24 warm against 4 for the second half, again confirming the Boston record.

"The outstanding contrasts are shown for the twenty years from 1856 to 1875 compared with the last two decades. Fifteen of the last twenty years were warmer than normal at both St. Paul and St. Louis, seventeen at Washington and sixteen at Boston, while for the two decades 1856-75, at St. Paul, Washington and Boston 18 of the 20 years had below-normal temperatures, and St. Louis 14 were below normal.

"For the Winter season (December-February) the same general temperature characteristics are shown. The chief features are the wide fluctuations and year-to-year alterations for the Winters of 1870-71 to the early Eighties. As in the case of the annual temperatures, a preponderance of warm Winters is shown for recent years. For the last twenty years thirteen Winters have been warmer than normal at St. Paul, seventeen at both St. Louis and Washington, and sixteen at Boston."

Industrial Building Now the Prime Market; 1941 Factory Building Up 85% Over 1940

By L. SETH SCHNITMAN

In the January issue of HEATING AND VENTILATING, Mr. Schnitman, nationally known economist, forecast the building outlook for the current year. During these extraordinarily difficult times such predictions are extremely hazardous and uncertain. Consequently, based on data at the mid-year, the author brings his forecast up-to-date. He emphasizes the present and future importance of industrial building as a market for building products and equipment.

NO one yet knows how great may be the ultimate expenditures for new building that will be induced by our all out defense effort, nor how permanent the additions to our national wealth they will afford, nor even how real the needs they essay to fill. But in the more practical immediate sense there can now be no doubt that the quickened tempo of our entire economy, as newly-ordered by the far-flung repercussions of the war abroad, has provided the basis for that high volume of building activity which already has become faintly reminiscent of the boom years of the nineteen twenties. This writer estimates that somewhere between 45 and 50% of the total volume of new building started during the initial half of 1941 the nation over, taking both residential and non-residential building together, may properly be classified as defense-induced building, both public and private. As was to be expected the greater weight of the defense effort has fallen upon the non-residential types, chiefly manufacturing buildings, for which current building operations have eclipsed all previous records.

Consider now the figures of F. W. Dodge Corporation for the first half of 1941 covering construction contracts of every description in the area only east of the Rocky Mountains. On this current statistical series the volume of construction undertaken thus far in 1941 has approximated $2,550,000,000, for an increase of about $925,000,000 or about 57% over the corresponding volume reported for the initial half of 1940.

Of this 1941 total a bit more than $1,900,000,000 represented the volume of building alone, both residential and non-residential. The remainder was accounted for by the sundry types of so-called heavy engineering construction, otherwise classified as public works and utilities, such as highways, bridges, power plants and the like. This latter figure, $1,900,000,000, itself represented an increase of virtually three-quarters of a billion dollars or almost 65% over the corresponding building total (exclusive of engineering) for the initial six months of 1940. Since this is a review and outlook for building only, we will henceforth limit discussion to this sphere of construction activity.

How then did reported committed building expenditures in the 37 Eastern States divide during the initial half of 1941? How do matters shape up for the balance of the year? We shall see.

Neck and neck has been this race against time in 1941 between residential and non-residential building needs and their satisfaction. By the end of June each had reached the finish line of around $950,000,000, though, in something of a photo-finish, *the race went to non-residential building*. Not so in the corresponding half-year of 1940, when *residential building* not only finished first but bested non-residential building by virtually $225,000,000. Besides this contrast, wrought largely by the forces of the defense effort, there are the contrasts that tell of a gain in residential building of only about 37% as against an increase in non-residential building of a bit upwards of 100% over their respective totals of the *first* half of last year; of an increase in residential building over the *final* half of last year of *under* 5% against the gain in non-residential building of *over* 15%.

Let's take a backward look here. Residential building in the first six months of the current year has outrun the record for any comparable six months since 1929; in the case of non-residential building as a whole, current performance has scaled all earlier records since that for the first half of 1930. For their bearing on the outlook from here out the following figures, arranged by half-year periods, should prove of more than passing interest and value, in that they indicate how great are the hurdles that lie ahead if new peaks for

TABLE I—BUILDING CONTRACTS AWARDED IN 37 EASTERN STATES
(F. W. Dodge Corporation. Millions of Dollars)

Year		Total Building	Residential	Non-Residential
1941	First Half	$1,906	$ 949	**$ 957**
1930	First Half	$1,637	$ 579	**$1,058**
	Second Half	1,286	522	**764**
	Total	2,923	1,101	**1,822**
1929	First Half	2,300	1,087	**1,213**
	Second Half	2,041	829	**1,212**
	Total	4,341	1,916	**2,425**
1928	First Half	2,767	1,531	**1,236**
	Second Half	2,459	1,257	**1,202**
	Total	5,226	2,788	**2,438**
1927	First Half	2,577	1,308	**1,269**
	Second Half	2,435	1,265	**1,170**
	Total	5,012	2,573	**2,439**
1926	First Half	2,550	1,377	**1,173**
	Second Half	2,539	1,294	**1,245**
	Total	5,089	2,671	**2,418**
1925	First Half	2,258	1,217	**1,041**
	Second Half	2,692	1,531	**1,161**
	Total	4,950	2,748	**2,202**

building as a whole are to be established, even though new manufacturing buildings alone have already attained this goal.

We will have some observations to make on the above figures a little further on; meanwhile, greater dissection of the 1941 results seem now in order. Where have the gains over 1940 come from? What type of building have chiefly accounted for them? May sustained volume be expected from here on; will significant further increases occur?

Gains in manufacturing buildings as a whole outclassed building operations in all other major structural types, principally because of an unexampled space demand from our mechanical industries, notably aircraft, parts, aluminum, munition and ordnance plants, automobile manufacturing—chiefly for trucks, tanks and airplane engines—even iron and steel mills. The process industries, too, contributed liberally, especially noticeable in the chemical and related fields. As a result, total expenditures for new manufacturing buildings (exclusive of heavy machinery and equipment) committed during the first six months of 1941 were more than four times as great as those in the like period of the previous year; in fact, the six months' total exceeded that for all of 1940. Were an adequate estimate to be included for expenditures to account for new space demands of factories in the 11 Western States that were on the way to being filled in the initial half of 1941, factory building operations the country over probably ranged somewhere between $575,000,000 and $600,000,000 during this period. Factory construction still remains the brightest spot in the building outlook over the balance of 1941.

With this unprecedented ground-swell in demand for new factory space there naturally came an in-migration of workers into defense areas and the collateral demand for their housing, this to say nothing at all of the increased demands for shelter for the Military. And so it was that, in the amount of gain over the corresponding period of 1940, speculative housing, i.e., that type of shelter erected by operative builders who specialize in 1-family dwellings for sale or rental, was second only to the gain in manufacturing building operations.

Adding the expenditures for this single type of housing to the committed expenditures for manufacturing buildings, the 37 Eastern States alone considered, one finds that these two classes of building operations together accounted for about 46% of all building. The balance of the building program thus far in 1941 went to commercial building, educational building, other public and quasi-public building such as hospitals, institutions, public administrative buildings, religious building and social and recreational buildings, to the sundry other miscellaneous non-residential building types, to hotels, apartments, 1-family houses for one's own occupancy, 2-family houses and to miscellaneous shelter.

What this means and what portent it may hold is perhaps best illustrated by contrast with conditions in the first half of 1940 when the incidences of the defense program were not only not so well defined as now but had far less effect in channelling the principal types of building operations. Then, manufacturing building and speculative 1-family housing, taken together, accounted for only about 31% of all building in the area east of the Rocky Mountains.

One might look further and find other facts on which to base a commentary on the current building scene but it would still add up to the same thing, viz., that besides providing the largest half-year building total since 1929 the defense effort has created the need for circumspection and for a new orientation as to the impacts of its forces running all the way from mounting building costs to questions of priorities for materials, transportation, even labor. That these considerations can now seriously shrink the building total for 1941 as a whole, is not likely; operations during the first half year have had too great a headstart for that to happen. But by the same token to expect, in the face of these now impelling elements, that the building results of the first half will be bettered or even equaled in the final half of 1941 would, at this writing, be like throwing all caution to the winds. For further reasons, light is shed by an examination of more of the details of the building picture of the first half of the year.

Though commercial building showed an increase of some 43% over the corresponding total of 1940, the improvement was due largely to probable non-recurring items now that defense is moving up into high gear; hence, it is unlikely that large increases, seen in the initial half, impend for the final half in such commercial types as commercial warehouses, loft and office buildings, even garages and service stations inclusive of airport facilities. And that goes even for 1-family houses erected by individuals for their own occupancy, where the gain was less striking.

This latter class of building during the first half of 1941 scored an advance over the previous year of less than 15%; here, priorities likely to be invoked later in the year, will probably take its greatest toll, especially as to houses costing in excess of $5,000 each to construct. Or take educational building. This class of operation during the first six months of 1941 showed only slight gain over the record of a year earlier, less than 2%. For hospitals and institutions the increase over 1940 thus far in 1941 was but a scant 6%; for public purpose buildings, less than 1%. Religious buildings were favored with a gain of around 15%, while social and recreational structures involved expenditures that bettered the 1940 record by a scant 10%.

It is of these classes, year in and year out, that enduring total building volumes are most often composed, much more so than in the more spectacular famine-or-feast fields of manufacturing buildings and speculative housing, no matter how real the needs may now appear, in terms of employment afforded and materials and equipment required, no matter how true it may be that no significant let-downs is in the nearby offing for manufacturing building. Take a look now at apartment house construction in these past six months, for here may be the true shadow of coming events that may prove of large meaning. Why? Chiefly because this type of building operation is principally reflective of investment as distinguished from speculative build-

(Concluded on page 53)

Large Canadian plants engaged in the manufacture of metal defense products are usually heated with either steam type unit heaters or with direct fired air heaters with distribution ducts in the floor or roof trusses. Smaller plants use either direct radiators or unit heaters.

Present Practice in Canadian Munitions Plants

By HARRY H. ANGUS†

IN the early stages of the war there was considerable confusion with regard to the type of equipment which should be made in Canada. The orders given out were generally of an educational type so that the manufacturer could accustom himself to munitions manufacture. In a few cases manufacturers had foreseen the trend of events in Europe and concluded that war was inevitable and had spent considerable time and money on the design of special equipment which they believed would be required.

After the capitulation of Norway and adjacent countries, there was a tremendous impetus given the war effort in Canada and the government gave large contracts for all classes of goods. This effort has been gradually stepped up until at the present time practically all manufacturers engaged in the metal trades or other industries connected with the making of goods for war are engaged directly or indirectly on war work. The smaller firms are mostly manufacturing component parts as well as jigs, dies, etc., and the larger firms complete units.

In general, the policy has been to have the work done by existing firms engaged in similar work. These firms have in most cases extended their capacity by the erection of new buildings or additions to present ones. Canadian firms now are manufacturing almost all kinds of war material.

Where large plant additions are necessary the government assists financially in the cost so therefore have a say in the size and type of construction. It has been their policy to have buildings and equipment designed suitable for the purpose but of economical construction so they will function during the war period. Due to the fact that the buildings are generally only for temporary use materials have been selected on this basis. More expensive construction and more elaborate plants would in many cases be warranted for permanent plants.

In general all types of plants engaged in metal trades are heated with steam type unit heaters or direct fired air heaters using distribution ducts in the floor or the roof trusses. The type of system to be used depends on local conditions as for any type of factory and ease of extension is very important. Additions and changes are liable to be made at any time so the heating plant must be located and designed for flexibility.

The fuel used is either oil or coal depending on the location of the plant. At present there is a ban on the use of oil for new plants due to the desire to keep down the rate of exchange on the Canadian dollar.

In the smaller plants the heating systems are standard types using either direct radiators or unit heaters. In the larger buildings unit heaters are used almost exclusively. In some cases floor type unit heaters are used but generally the heaters have been placed at the ceiling so that extensions can be easily made and also because there is then no danger of the heaters interfering with proper location of production machinery.

With regard to the airplane industry, the Canadian scheme for training pilots, observers, etc., is very complete and this has had an effect on the type of airplane plants to be built. There are two types of these, one being for repair and overhaul, and the other for manufacture of new planes. There are a number of repair and assembly plants located across the country, with

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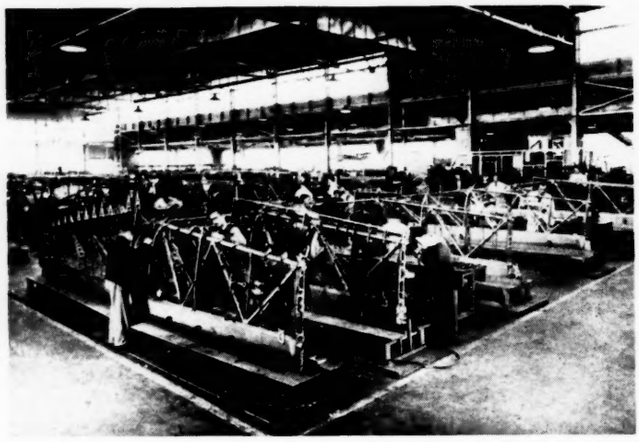
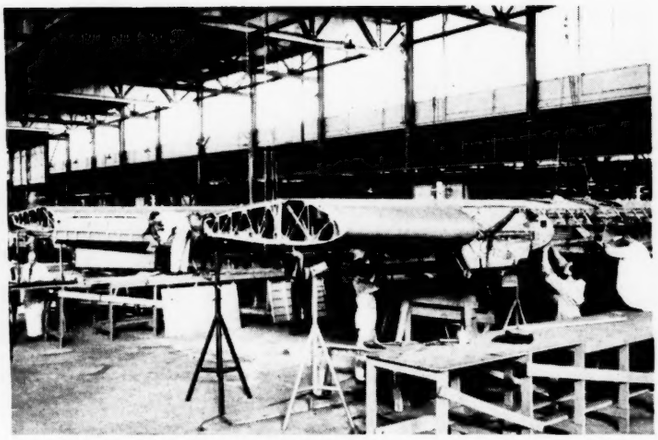




Two views of the interior of a typical Canadian airplane manufacturing plant. The ventilation of the dope rooms where all painting and spraying is done is particularly interesting since the paint usually contains large proportions of highly explosive volatile matter. Ventilation is necessary to combat explosions and for the workers' health.

the idea of having these within reasonable distance of flying fields.

The difference in the two types of plants is that the manufacturing plant is designed for manufacture of one plane while the repair and overhaul plant has to be arranged so that it can service any type of plane used in the section of the country in which it is located. In all manufacturing plants many of the component parts are made by sub contractors and the main plant assembles these and also makes some parts.

Assembly plants usually have a clear height of 25 feet or more with clear spans around 100 feet.

Where steam heating systems are used, unit heaters are placed in the roof trusses so they will not interfere with the floor space. While the space required for present type of planes is known, it is felt that larger type of planes may later be repaired or manufactured and the full area of the building for the full height to the roof trusses should be available if necessary. In general, unit heaters are of the vertical down blast type or multiple fan type with cowls to direct the heated air to the floor. In Canada special provision is generally made to offset the loss and discomfort when the large doors, which are generally 25 feet high and up to 130 feet wide, are opened. This is done by providing a curtain of warm air in front of the doors either from a duct running the full width of the doors or from specially arranged unit heaters. In some cases a canvas curtain hung about 50 or 100 feet back of the door is supplied and this is pulled across the room to stop the cold air getting back into the main part of the plant when the doors are open.

There are a number of sections of the airplane plant requiring special treatment such as plating rooms, sand blast rooms and dope rooms. In most repair shops there is a section devoted to engine overhaul and this has to be complete with engine test rooms which are usually located in separate buildings having two engine test rooms per unit with a room between for the instruments and the observer.

Steam systems are generally operated with low pressure boilers at about 10 to 15 lb per sq in. for the smaller plants but on the larger ones steam is generated at from 60 to 100 lb per sq in. and reduced to 25 to 50 lb per sq in. in the plant for use in the unit heaters.

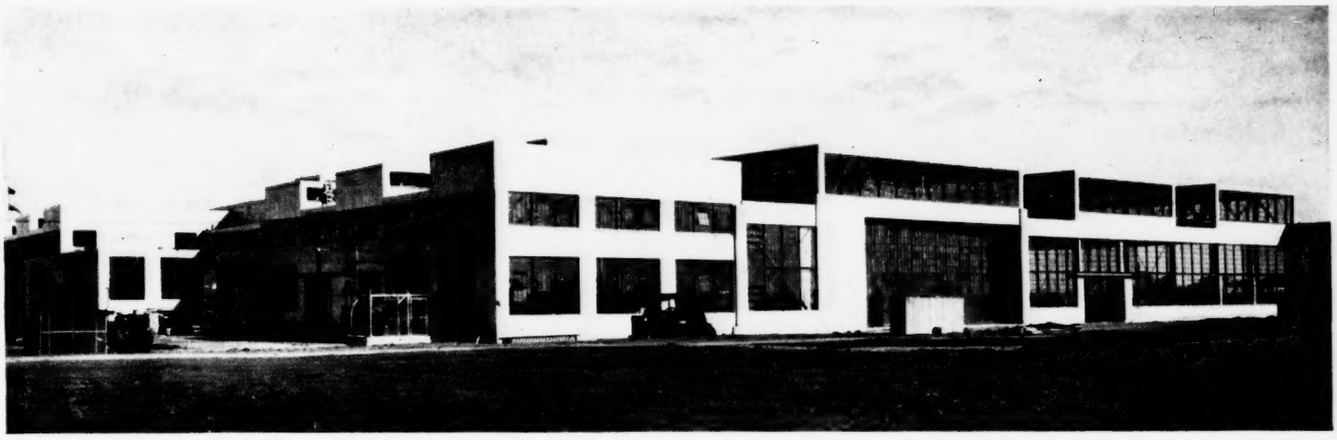
A good supply of compressed air is necessary as there are a large number of pneumatic tools in use. In the large assembly bays it has been found convenient to carry compressed air lines in shallow trenches in the floor and install outlets on these about 30 feet apart to which the operator's compressed air hose can be attached.

One of the interesting features is the ventilation of the dope rooms where the canvas is put on the frames and all painting and spraying is done. The ventilation of these rooms is necessary first to overcome danger of explosion, and secondly to provide for the health of the operators. The dopes or paints used contain a large proportion of explosive volatile matter and the problem is to dilute this with sufficient air.

The dope rooms are generally separated from the main plan by masonry walls with fireproof doors for access. All electrical equipment in them must be explosion proof type, and all motors completely enclosed explosion proof type. Fans handling the gases should have aluminum or other non-ferrous blades to prevent sparks in case of contact.

For production work it has been the custom to provide booths in which the spraying is done, and these are of size to accommodate the work. In general, heated air is supplied at one end of the booth and passes over the surfaces being sprayed and is exhausted at the other end. A velocity of 100 to 150 fpm over the cross sectional area of the booth is usually sufficient to prevent concentration of explosive gases and give reasonable protection to the operators. Where the booth is used steadily a water spray is provided at the exhaust end in front of the fan to take out the main particles which are deposited in a tank of water and reclaimed.

In dope rooms for overhaul and repair plants the problem is more complicated as the dope rooms must be able to accommodate any part or the assembled plane. Such rooms may have a floor area up to 8000 sq ft and a height of 15 or 20 ft. This type of room does not lend itself readily to the horizontal movement of air. With a width of probably 60 ft or more it would require 90,000 cfm to provide a velocity



Exterior of a typical Canadian airplane manufacturing plant. Many Canadian buildings erected for defense are built for temporary use only and the materials have been selected on this basis. This causes the heating and ventilating practice to differ somewhat from practice in permanent buildings.

of 100 fpm. On a day with the outside temperature of zero, this would require about 7500 lb steam per hour, or 230 boiler horsepower. Where a number of operators are working on a wing or fuselage there is also the difficulty that the gases from the operators farthest from the exhaust are carried over the other operators before reaching the exhaust outlets.

A system of ventilation with downward movement of air has many advantages for this reason. In this the air is distributed by ducts above a hung ceiling and passes vertically through the rooms to concrete floor ducts covered with wood gratings which convey it to the exhaust fan. With the downward system of ventilation the gases are removed near the point generated and do not affect the other operators in the room. The air in this case merely pushes the vapors below the breathing line and a lower velocity will give good results as there is not the same tendency for the vapors to spread as there is with the horizontal system, also the vapors do not need to be carried so far.

With the downward system for general work it is a simple matter to close off any portion of the floor grille system with rubber mats which will concentrate the exhaust in the section of the space that is in use at any one time.

The air supply for the dope rooms may be taken from the main shop or may be drawn in from outside. In either case it will have to be heated to some extent to maintain a temperature of around 70F in the dope room.

As already noted, the exhaust fan should have aluminum or bronze blades which can be easily cleaned, and the fan should be of the elbow type or driven by a belt so that the gases will not pass over the motor.

Air Conditioning for Concrete Testing Laboratory

In the flood of defense orders, materials must meet rigid specification, and the work of testing laboratories becomes increasingly important. Refrigeration is playing a big part in helping to create test conditions, its role being usually associated with sub-zero, or at least sub-freezing, temperatures.

In the curing room of the concrete testing section of the Pittsburgh Testing Laboratory, Pittsburgh, Pa., however, refrigeration helps to maintain an atmosphere like that of a very sticky day in June. In this room, where concrete cylinders and building blocks are cured for periods ranging anywhere from seven to 28 days prior to being tested for quality, strength, and durability, it has been necessary to maintain the temperature at 70F, plus or minus three degrees, and the humidity at never less than 90 per cent.

Commercial refrigeration dealer Brown Bricker, of Pittsburgh, turned the trick with the following equipment. Two General Electric conditioned-air cooling units, each equipped with a 500-watt Calrod heating unit located in front of the blower, provide both cooling and heating. The room temperature is controlled by two thermostatic controls arranged so that the heaters will cut in when the temperature drops, and the cooling will cut in when the temperature rises. A slow-speed 1-hp condensing unit, equipped with a Hubbeli pressure regulating valve to maintain a high-back pressure, supplies the cooling coils. The unit is operated on a 10F temperature difference to keep condensation at a minimum. Humidity is maintained by a special spray nozzle located in front of the heater and blower.

A seven-day recording instrument reveals that this equipment keeps the temperature in the curing room within one degree of the required temperature and maintains an average relative humidity of 94 per cent. This is well within the limits set by the American Society for Testing Materials, the U. S. Navy, U. S. Army, American Association of State Highway Officials, and Federal specifications for testing of Portland and masonry cements, fine aggregates for concrete, tests of concrete cylinders cured under laboratory conditions, soundness tests of building stone, and concrete aggregates by sodium and magnesium sulphate methods.

The curing room in the Pittsburgh Testing Laboratory can hold as many as 1200 samples and of late it has very often been filled to capacity. The Laboratory has testing machines ranging in capacity from 2000 lb full load to 6000 lb, a machine for torsion tests of 60,000 in. lb capacity, and equipment for determin-coefficient of expansion.

BELL AIR

AIR CONDITIONING FOR DEFENSE

Special arrangement of unit heaters have been provided on either side of the 195 ft canopy door through which Airacobras move from assembly lines on to the apron for flight tests.

AIRACOBRAS for the United States Army Air Corps are now rolling off two conveyorized production lines in the new assembly plant recently completed for Bell Aircraft Corporation at Niagara Falls (N. Y.) Airport. Two more lines, already installed, will soon begin to move and provisions have been made to increase the number of production lines to six.

Inside this modern daylight plant which The Austin Company designed and built to expedite application of Bell's new concept of aircraft production, every facility has been provided for efficient workmanship and speedy handling of parts and sub-assemblies right through from receiving platform to the hangar area where completed planes await inspection and flight tests.

With four main assembly lines side by side and extending from east to west through the center of the plant in a high bay with 30 ft clearance below roof trusses, most sub-assembly work has been concentrated in four lower 50 ft monitor bays. Front and rear fuselages are completed in the two bays on the south and wing sections and cabins are built up on the north side. Cranes and monorails facilitate the movement of parts and sub-assemblies in each department, where paint spray booths designed to meet the specific requirements of each unit have been located to eliminate unnecessary handling.

Most of the building exterior is finished in buff face brick and limestone although the airport facade has contrasting red brick below the windows with the entire hangar door area framed by panels of buff porcelain enamel. Massive 4 ft block letters in blue porcelain enamel have been recessed above the canopy doors and clearly identify the plant.

Offices are located in the southwest corner where curves and angles have been combined to provide interesting modern detail at the entrance. Fixed awnings in the form of steel fins extend out from the walls above continuous sash at two levels in this section, as protection against the sun.

Thirty-five individual offices have been provided in this section, where an area of 10,000 sq ft has been partioned with removable steel panels which afford absolute privacy but can be shifted about, if necessary, when conditions change. Main offices of the plant will continue to be located in Buffalo for the present, so that principal requirements at Niagara Falls plant are for accounting, timekeeping and inspection departments, production executives and engineers, and for the Army. In addition to Army staff offices, a radio control room, pilot's lounge and a room for its inspectors have been provided. Space has been reserved for the plant's aerodynamics staff in this office, where first aid and dispensary facilities are also located.

While the building is not air conditioned a number of features were incorporated into its design to help keep the temperature low during the summer. First, all of the working area ceilings are quite high. Second, the roof was designed to provide the maximum amount

CRAFT OPENS NEW PLANT

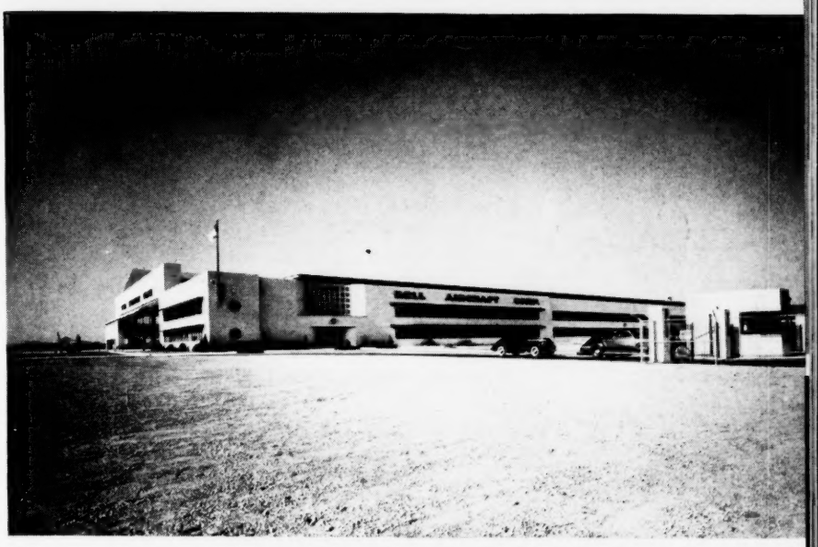
of insulation, and third, fixed awnings, as mentioned previously, extend out from the walls over the windows over the office space. Fourth, Aklo glass which is a specially designed glass to reduce the transmission of solar heat is used on the southern and western sides of the building.

The building is heated from a separate boiler house which is equipped with two 300 hp oil fired boilers. Steam is supplied from this boiler house to the main plant for use in the unit heaters and heating equipment in the office space.

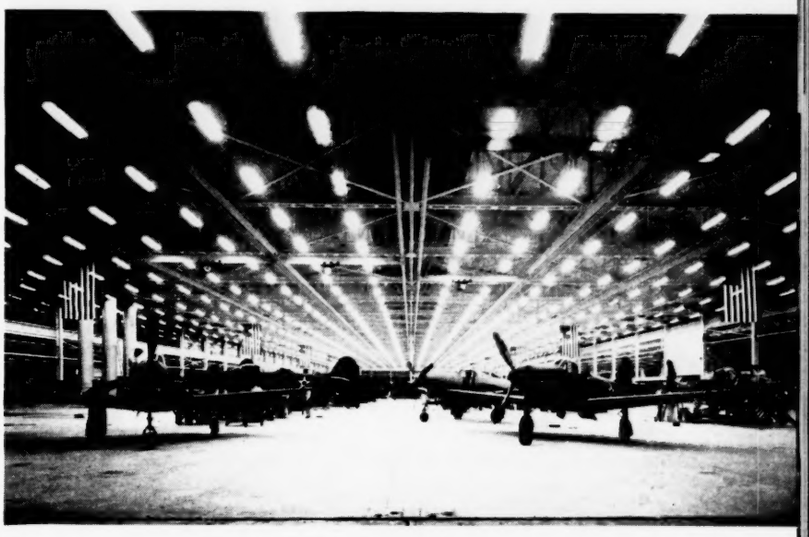
Generous areas of sash in side walls, monitors and skylights above the center bays provide an excellent distribution of daylight, which has been controlled by the use of Aklo glass on the south and west. This illumination is matched at night by the most modern of fluorescent lighting facilities, which reach maximum efficiency in an interior where walls and structural steel are all painted white.

The roof was designed to provide the maximum of insulation, Summer and Winter. It has 2½ in. of reinforced gypsum, poured in place over 1-in. insulating board, which rests on 15 lb rails that were welded to the steel purlins. This deck was covered with a 20-year tar and gravel bonded roofing.

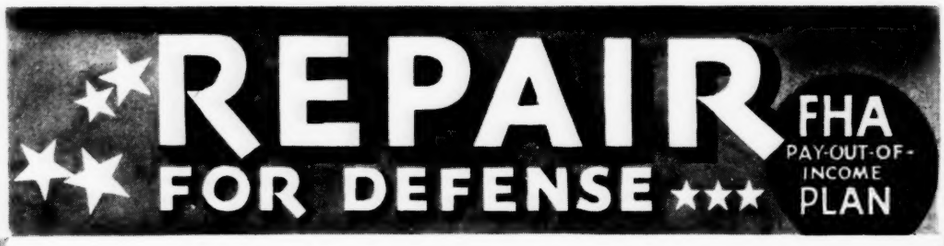
Project Described
Designed by
THE AUSTIN CO.



The new assembly plant of the Bell Aircraft Corporation at Niagara Falls Airport, N. Y., illustrates the manner in which modern functional lines are being applied in defense plants.



(Above) Four conveyorized production lines inside the assembly plant are assured the equivalent of daylight by use of rectified fluorescent lighting. (Lef)t Three fans which move 45,C00 cfm of air draw fumes from the paint spray through the floor grille and exhaust them through the roof. (Below) The interior of the assembly plant.



FHA Announces New Campaign on Defense Modernizing

"REPAIR for defense", a theme stressing property preservation and the remodeling of homes in defense areas, will be the basic appeal of a new repair campaign sponsored this fall by the building industry, financial institutions, and the Federal Housing Administration.

To convert old homes into defense housing and to prepare the "home front" for its job at the bulwark of America's defense, articles and advertisements in newspapers and magazines, announcements over radio stations, window and transportation posters, local demonstrations, booklets, and other means of public education are being made ready throughout the nation.

Brand new provisions of FHA's property repair (Title I) plan will back up the new drive with proper financing facilities. FHA Administrator Abner H. Ferguson, commenting on the 1941 program, said: "This effort of the building and allied industries to do the big job of housing workers in our defense industries find the machinery already organized and running efficiently—thanks to seven years' experience in a nationwide program of encouraging constructive home improvements."

The 1941 program, aimed exclusively at defense production areas, will encourage the conversion of old houses into multiple-family dwellings or rooming or boarding residences.

While the building industry is believed ready to construct as many new homes as required in such communities, it is realized that every available home already built should be utilized. Needed housing can be supplied quickly and economically from large well-located homes which are not being fully used. This is described as a sensible "short cut" to additional defense housing.

Organizers of the 1941 drive are also aware that there is no economy in allowing homes to go to pieces through neglect during the present period of emergency. The total value of homes in this country, it is estimated, is around 80 billion dollars. Even normal obsolescence amounts to about 2 billion dollars annually. With one-third of the homes in the United States between 25 and 50 years old, the wisdom of "a stitch in time" is obvious.

Building construction leaders and FHA officials point out that the housing industry is one business which the present crisis finds prepared for effective national action. National emergencies and programs are nothing new to the home building business, which in 1934 was faced with starting an almost paralyzed industry on the job of doing billions of dollars in home repair and new construction. Its success in organizing a national program to surmount that problem makes the building industry confident it can house defense workers and maintain America's housing equipment in adequate condition and quantity dur the present emergency.

The new program will make strong use of the slogan "Defense calls for Home Repairs". Builders, contractors, financial institutions, material manufacturers, dealers, and others will cooperate to spread this theme from coast to coast through national and local advertising. The entire program is modeled after previous successful campaigns by the building and allied industries.

All who participate will be entitled to educational, display, and other promotional material supplied by FHA without charge.

This 1941 program, in which thousands of business concerns are expected to cooperate, will continue through the fall season. Many items of tie-in material are available through local media such as newspapers, radio stations, motion picture exhibitors, transportation advertisers, etc. Requests for booklets, window display material, dealer helps, etc., should be addressed to the Division of Education, Federal Housing Administration, Washington, D. C.

PROFITS IN AIR

Interior of the final inspection room of the Greenfield Tap and Die Corporation, maintained at 68F and 50% relative humidity, the recognized standard at which gages are calibrated.

A SECTION OF "HEATING & VENTILATING" SHOWING HOW INDUSTRIAL PLANTS PROMOTE PROCESSES AND PROFITS BY SCIENTIFIC CONTROL OF ATMOSPHERIC CONDITIONS

PROFITS IN AIR

KOLLSMAN INSTRUMENT COMPANY,

Division of Square D Co., installs its third air conditioning system to increase airplane instrument production.

By A. A. GIANNINI†

SPEEDING up the production of airplane instruments in the National Defense Program will be an important result of the installation of a new and unique air conditioning system at the Kollsman Instrument Company, Elmhurst, Long Island—one of the foremost companies in this rapidly growing field. This latest system is the third for the plant, and incorporated into it are all the features found desirable in the previous two.*

Need for Air Conditioning

In the delicate operation of assembling precision aircraft instruments, constant humidity and temperature conditions are of prime importance. The surrounding air must also be free of dust and dirt. The proper degree of humidity must be maintained because the slightest perspiration on the hands of employees handling the delicate instruments tends to cause tarnishing or rusting of the various parts going to make up the complete instrument.

Some of the parts are so precisely machined that even the slightest blotch of oxidation caused by excess humidity or dust particles affects the accuracy of the instruments. Moreover, constant temperature control is important as the tolerances are so close that variations in temperature have a tendency to make the instruments vary from the test standards.

The above specific benefits of air conditioning to this type of manufacture are all the more significant when it is understood that the assembled instruments must be tested subsequently in an isolated cold test chamber in which the temperature is maintained at —40F and at a vacuum corresponding to an altitude of 50,000 ft —thus simulating the most severe flight conditions.

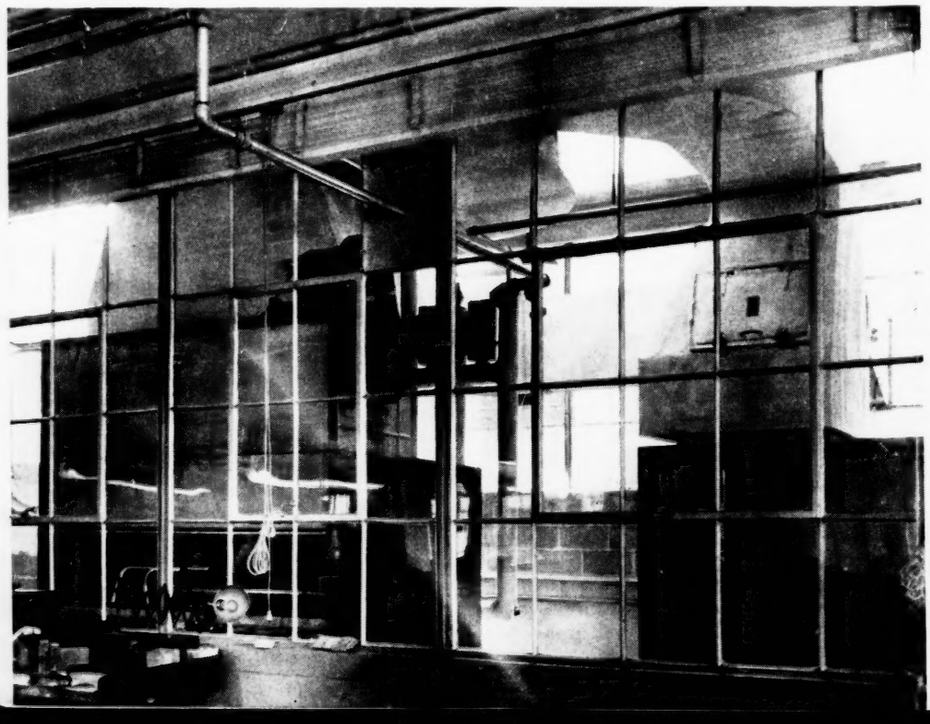
Because of the extremely low temperature maintained in this test chamber—accomplished by a cascaded system of direct expanding refrigerant—rapid condensation of excess atmospheric moisture collects on the surfaces of the instruments, when removed from the test chamber. As a result a frosting occurs which makes inspection quite difficult. Moreover, unless the excess moisture is removed from the inside of the casing of the instruments during assembly, such moisture will condense and freeze when subjected to the low test temperature and cause damage.

Equipment

To prevent these production handicaps, a separate air conditioning system for the assembly room was de-

†Carrier Corp., New York City.

*For a description of one of the earlier installations see HEATING AND VENTILATING, Nov. 1940, page 36.



(Left) Fig. 1. View from plant working area into air conditioning machine house. It was originally planned to install air conditioning equipment in the plant itself but need for all of the space for production made it necessary to install air conditioning equipment in small addition. (Right) Fig. 2. Carrier silica gel dehydration equipment provides independent control of humidity. Photo shows exterior of dehydration unit, together with supply and outlet ducts. (Extreme right) Fig. 3. A section of the air cooling unit showing inlet ducts, filter, casing, and belt drive for fan.

HOW INDUSTRIAL PLANTS PROMOTE PROCESSES AND PROFITS BY SCIENTIFIC CONTROL OF ATMOSPHERIC CONDITIONS

signed and installed to maintain an 80F dry bulb and 35% relative humidity. These conditions do not entirely eliminate condensation on the surfaces of the instruments—but it is decreased to a satisfactory point. The essential apparatus consisted of silica gel dehydration equipment, for humidity control; and direct expansion refrigeration equipment, for temperature control. This arrangement provides dehumidification independent of cooling and automatic operation of only that part of the equipment required by varying load conditions.

Not the least of the important advantages of this air conditioning system was the fact that the employees enjoy complete comfort which is very desirable as a means of speeding production.

Choice of System

The question might arise as to why the conventional mechanical refrigeration system was not selected for this particular application. The answer to that question lies in the weighing of all the many variables in the light of conditions of use. There are no fixed rules.

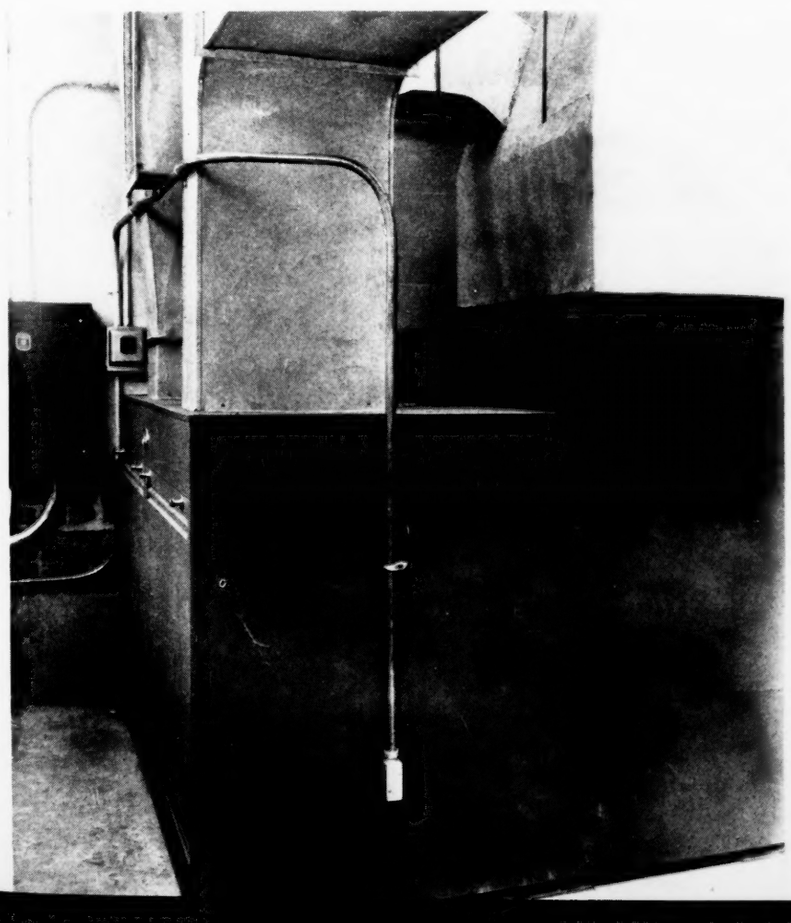
In other words, since the principal function of direct dehumidification by means of silica gel dehydration equipment is to produce dry air and to maintain dew-point temperatures *independently* of cooling, and since the function of mechanical refrigeration is the simultaneous control of temperature and dehumidifying, the use of either type equipment must be qualified economically as well as technically before it can be intelligently selected.

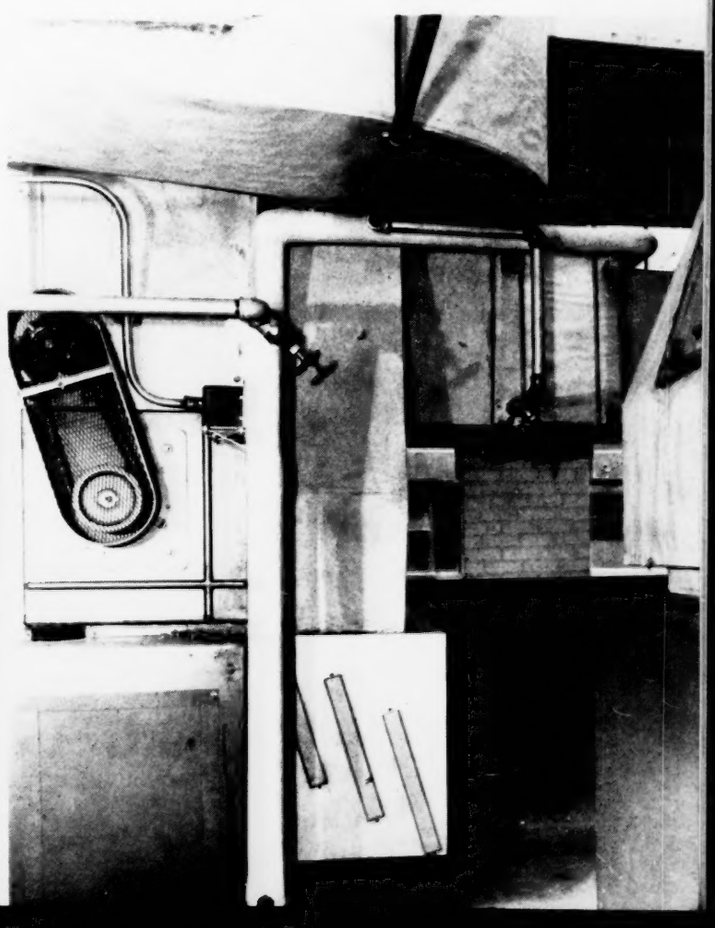
For example, when the amount of dehumidification required for any one specific application need not extend beyond that obtainable as a by-product of low temperature cooling, the conventional refrigeration system is likely to be lower in first cost as compared with a dehydration system in combination with refrigeration and designed for the same duty.

In the case of the Kollsman air conditioning installation the combination of direct dehydration and refrigeration equipment was selected because of the following three essential qualifying factors:

1. There exists a comparatively large percentage of latent heat load to total load.
2. It is essential to maintain precise humidity conditions independently of dry bulb temperature conditions at all times.
3. It was practical to take advantage of the availability of gas at low cost to provide the heat for regeneration of the absorbent, silica gel.

The design of and selection of equipment for this combination system took into account the fact that the maintenance of the exacting inside conditions must be assured for more than just one combination of outside dry bulb and wet bulb temperature conditions. The





system must perform during sunless, muggy days as well as hot, dry days.

That is, both inside and outside loads vary over wide limits. Thus the equipment is seldom required to perform with a load ratio equal to one specific combination of design conditions. (For instance, cases arise where the ratio of latent heat to total heat is *increased* because of the *decrease* in the sensible load, but without a corresponding decrease in the latent cooling requirements).

In order to meet these variations in loads and to provide a system with the widest flexibility and overall economy, a maximum outside design wet bulb condition was selected at moderately lower dry bulb conditions, as distinguished from conventional design conditions which are usually based on a maximum dry bulb condition.

This means that when the outside temperature is *below* 95, for example, with a corresponding *higher* moisture content, this system is capable of maintaining the specified inside conditions despite the higher outside relative humidity represented by the change in outside conditions. This feature prevents the cold damp inside conditions prevailing on those muggy days of high outside humidity and relatively lower temperature.

It is to be noted from the flow diagram in Fig. 4 that the independent control of humidity and temperature is obtained by having the room hygrostat control, the silica gel dehydrator and a two-stage thermostat control the refrigeration or cooling phase.

The refrigeration equipment is used for sensible heat removal, only; so that, with this control setup, the desired inside conditions can be readily maintained under any variation of sensible heat ratio, i.e. $\frac{\text{Sensible Heat.}}{\text{Total Heat}}$ This is illustrated in Fig. 5.

The sensible heat ratio is represented by the slope of the dotted line R-S. As this ratio varies to some other ratio line such as R-W (due to changes in atmospheric conditions), the desired condition of the supply air would be at point W. To meet this new supply air condition, the automatic intermittent operation of the compressors shortens the line C-S and the intermittent operation of the dehydrator has the effect of raising the horizontal level of line A-B. Thus the desired condition is produced.

In contrast to this scheme, Fig. 6 shows the cycle of a conventional refrigeration system which provides simultaneous cooling and dehumidification by direct expansion,—plus re-heat.

Applying this type system to the Kollsman Instrument installation, Line R-B represents the sensible heat ratio. On the basis of a total air quantity of 6000 cfm. the required condition of the delivered air is represented at point S. Because of the low sensible heat ratio, line R-B would meet the saturation line at a temperature below freezing. It is not practical therefore to attempt reaching a point at which the air conditions satisfy both the sensible and latent loads without reheat.

It will be noted that, with this alternate scheme, this air cannot be cooled directly from point M to point S, but rather must first be cooled to the saturation line and then subsequently be cooled to some point such as C. The air is then reheated to S.

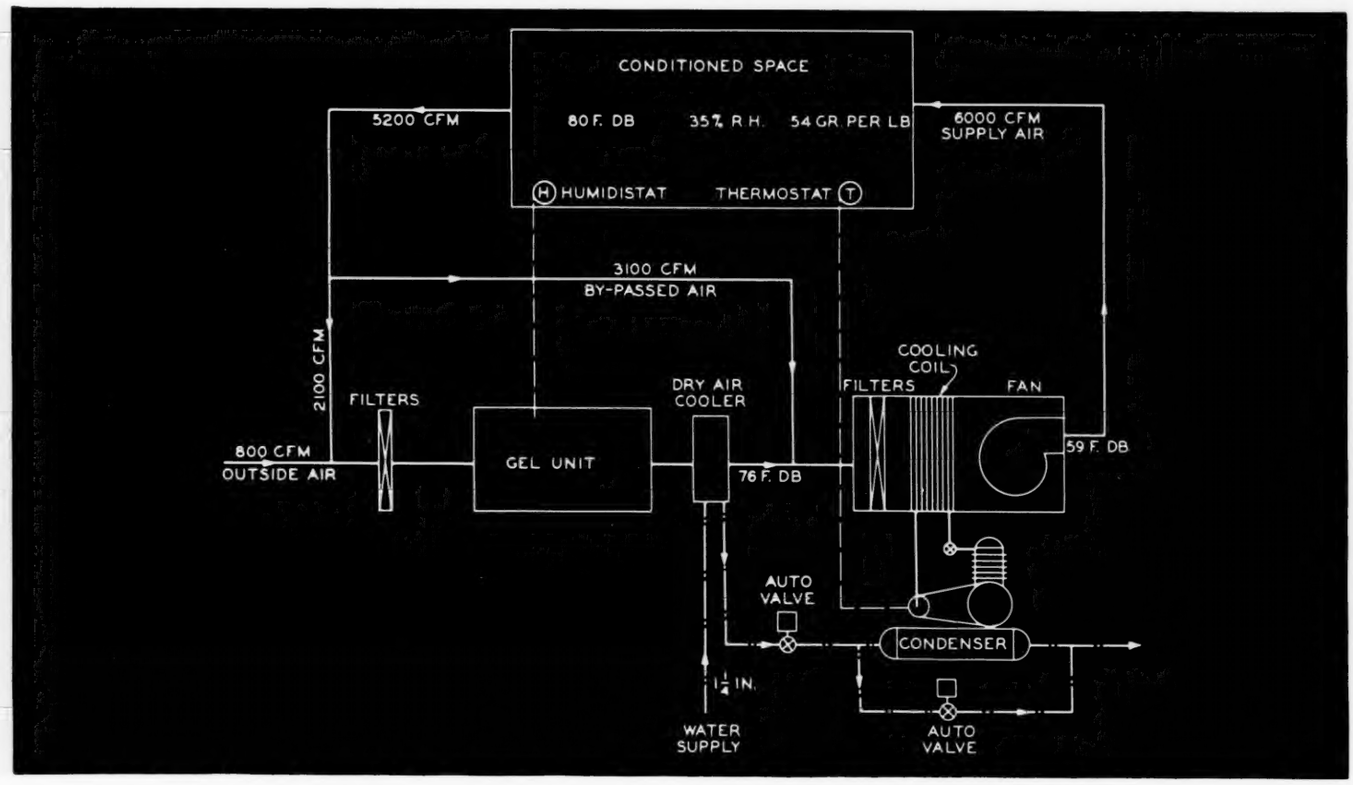


Fig. 4. Schematic diagram of the arrangement of the air conditioning equipment for conditioning the aircraft instrument assembly room. Note that the water is first used for cooling the air leaving the dehydration unit before it goes to the refrigerating condenser. Due to the use of the separate silica gel dehydration unit and refrigerating system, independent control of temperature and humidity are made possible. Gas is used for reactivating the gel unit.

TABLE 1.—COMPARISON OF TWO SYSTEMS UNDER MAXIMUM LOAD CONDITIONS OF 95F DB AND 123 GR PER LB OF DRY AIR

	System 1 Refrigeration and Dehydration	System 2 Refrigeration and Reheat
Room Sensible Heat Btu per hr	137,000	137,000
Room Latent Heat Btu per hr	49,500	49,500
Total Air Supply Btu per hr	6,000	6,000
S.H.R.	.735	.735
Load on Compressor Btu per hr	125,000	325,000
Reheat Required Btu per hr	None	84,000 *
H_2O Required gpm	29	38
Connected hp	18	33
Kwhr	14.5	27.5
Gas Required cfh	550	None

*Steam for reheating is not available at the Kollsman plant during the summer, therefore had System 2 been selected, hot compressor discharge gas would have been required.

OPERATING COST

	System 1	System 2
Power at 1.82c. per kwhr*	26.5c.	50.0c.
Gas at 35c. per 1000 cu ft	19.3	None
Water at 1.50 per 1000 cu ft	34.8	39.5
	80.6c.	89.5c.

*Includes demand charges

TABLE 2.—COMPARISON OF TWO SYSTEMS UNDER PARTIAL LOAD CONDITIONS OF NO SUN AND 85F DB—123 GR PER LB OF DRY AIR

	System 1 Refrigeration and Dehydration	System 2 Refrigeration and Reheat
Room Sensible Heat Btu per hr	60,000	60,000
Room Latent Heat Btu per hr	49,000	49,000
Total Air Supply Btu per hr	6,000	6,000
S.H.R.	.550	.550
Load on Compressor Btu per hr	48,000	307,000
Reheat Required Btu per hr	None	160,000
H_2O Required gpm	22	35
Connected hp	18	33
Kwhr	9.5	26
Gas Required cfh	550	None

OPERATING COST

	System 1	System 2
Power at 1.82c. per kwhr	17.3c.	47.5c.
Gas at 35c. per 1000 cu ft*	19.3	—
Water at 1.50 per 1000 cu ft	26.4	42.0
	63.0c.	89.5c.

*Special air conditioning rate

Should the load ratio change so that the desired conditions of the supply air is at point W, further reheating is necessary.

Under maximum design conditions, the comparison of operating costs for the two types of systems is shown in Table 1.

Under partial load, the comparison is as shown in Table 2.

From the foregoing it is readily seen why it is impractical to set up fixed rules regarding the initial cost of the combination system as compared with the straight refrigeration system. The initial cost of both types of systems in this case is substantially the same. However, the operating costs, under both maximum and partial load operating conditions, are favorable to the combination dehydration and refrigeration system. For these reasons, coupled with other collateral advantages, previously mentioned, this type system was selected.

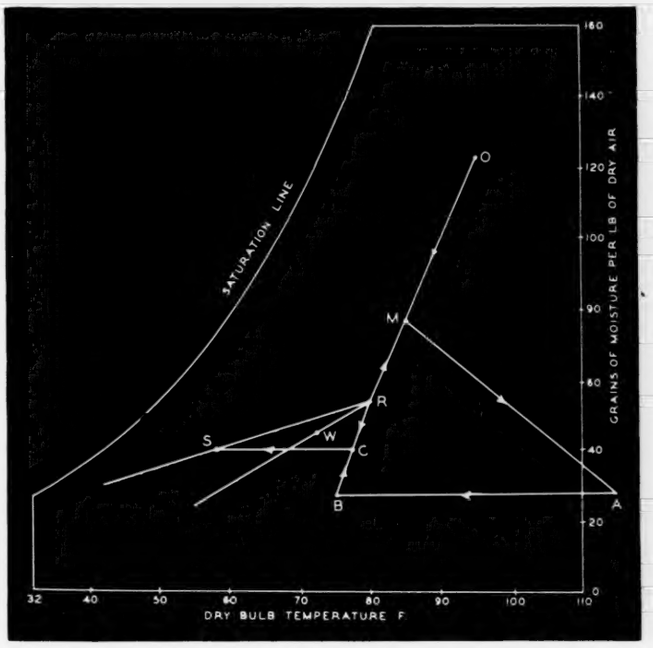


Fig. 5. Outline of a psychrometric chart showing the cycle of the conditioning system installed in the Kollsman Instrument plant. Outside air at condition O and room air at condition R are mixed to provide condition M. This air enters the dehydrating unit and leaves at condition A. It is then cooled to point B and mixed with some room air to give condition C. This mixed air is then further cooled to condition S at which it is supplied to the room. Line SR represents the heat and moisture picked up in the room.

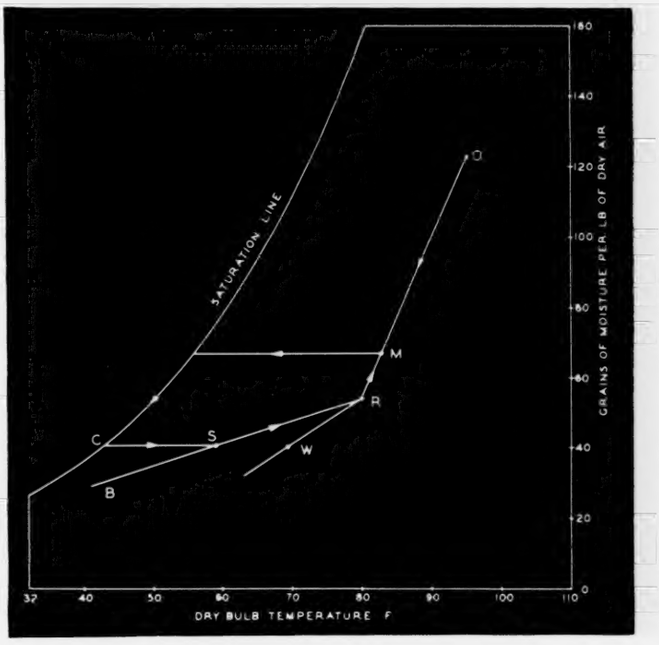


Fig. 6. Diagram of the cycle of a conventional refrigerating system which provides for simultaneous cooling and dehumidification by direct expansion plus re-heat. In this diagram the outside air and room air are mixed to give air at condition M. This air then passes through the cooling coil where it is both cooled and dehumidified to condition C. It is then re-heated to condition S which is the condition for the air entering the room. Line SR represents the heat and moisture picked up in the assembly room.

PROFITS IN AIR

GREENFIELD TAP & DIE CORP.

builds plant to quadruple its gage production facilities. Air conditioning, by eliminating expansion and contraction of metal, assures accuracies to 0.0001 inch as well as increasing output.

By A. S. MacNEISH†

PROFITS IN AIR

NO. 50 OF A SERIES DEALING WITH ATMOSPHERIC CONDITIONS IN INDUSTRIAL PLANTS.

THE new Gage Building of Greenfield Tap & Die Corporation plant at Greenfield, Mass., is a two-story and part basement structure, approximately 200 by 80 ft, constructed especially for the finishing operations and inspection of precision built gages. To facilitate and improve on the manufacture of this equipment, made regularly within tolerances of 1/10,000 inch, the building is air conditioned throughout.

The building, dedicated May 30, is of brick and concrete construction, has very few single glazed windows, but has large areas of glass block surfaces in the North and East walls. The roof is insulated and flooded. Fluorescent lighting is used throughout the building, maintaining a uniform average intensity of 22 foot candles.

The air conditioning installation consists of two distinct systems, one serving the manufacturing space on the two floors of the building, called the *building system* and the other serving the final inspection room.

†Mechanical Engineer, McClintock & Craig, Inc., Engineers and Architects, Springfield, Mass.

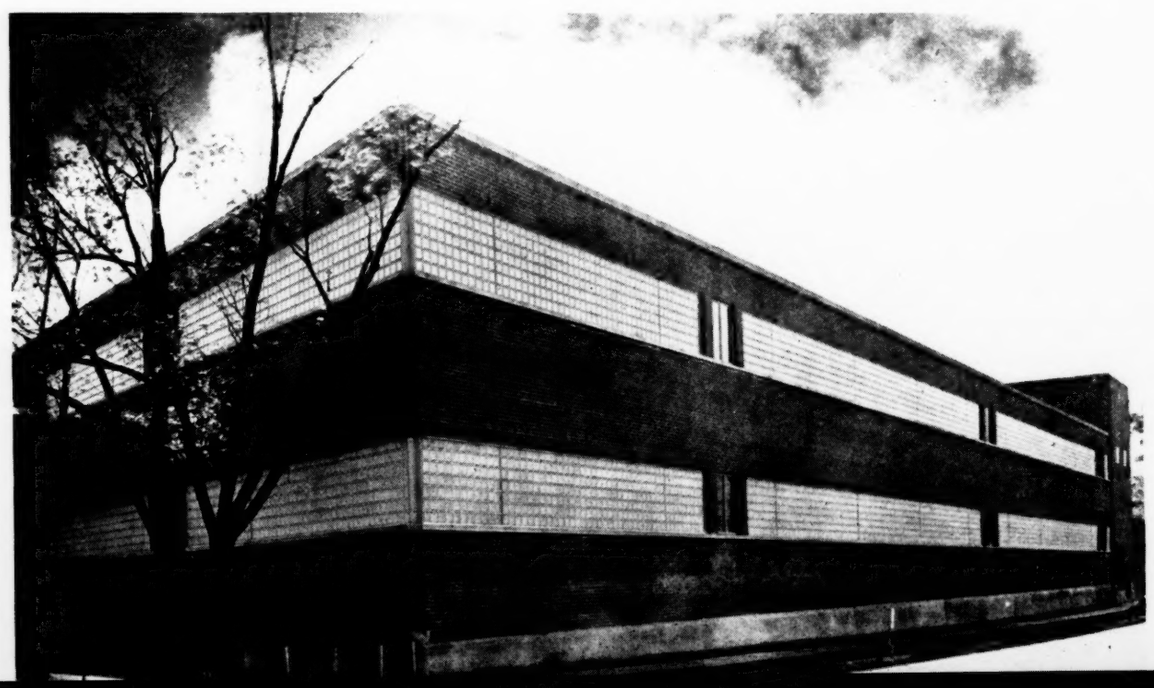


Fig. 1. The new air conditioned gage plant of Greenfield Tap & Die Corporation where all finishing operations after heat treating are concentrated.

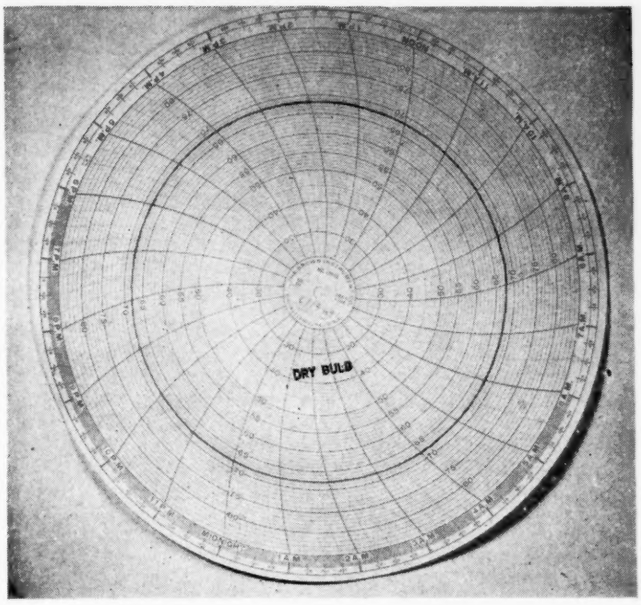


Fig. 2. A typical chart of dry bulb temperatures in the final inspection room.

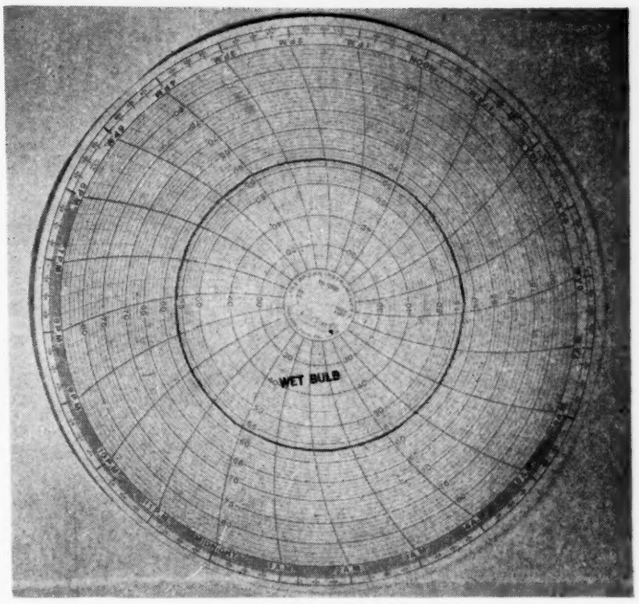


Fig. 3. A typical chart of wet bulb temperatures in the final inspection room.

Building System

The building air conditioning system evolved from various requirements of the owners, viz.: artificial ventilation, which requires indirect heating; elimination of atmospheric and manufacturing dust requiring filters; and, stabilizing of temperatures which requires heating and cooling. To fulfill the composite of these requirements, an air conditioning system is installed.

It should be noted that stabilizing of temperature and not comfort conditioning, a secondary consideration, was required. The purpose of this was to eliminate hour to hour temperature fluctuations, which cause continuous expansion and contraction, which would do no appreciable harm if the measuring devices and the work expanded and contracted in unison; however, in practice due to the difference in metal materials and thicknesses, there is a lag and a consequent potential loss in accuracy.

The system is designed to maintain uniform temperature throughout day and night operations. It is expected that the maintained temperature will be adjusted weekly or monthly during week-ends or other shutdowns, changing by increments with the seasons from 68F in winter to 78F — 80F in summer. In this way the most economical operation can be obtained with no loss in the accuracy of manufacture.

For the building system there is one central fan, filter, heating and cooling coil assembly on each of the two floors. To the first floor, 20,500 cfm of air is supplied at a maximum differential in temperature between entering air and room air of 20F. Re-circulated air totals 16,873 cfm and the balance of 3627 cfm is fresh air. This provides 36 cfm of fresh air per occupant and gives six complete changes of the room air per hour. Similarly, the second floor is supplied with 14,700 cfm; temperature differential between entering air and room air is 15F; fresh air supply is 3627 cfm or 36 cfm per occupant.

There are four changes per hour of the air in the second floor. The air supply system in both floors is similar. The return air from the room and the fresh air combine and pass through an automatic self-cleaning air filter, then through evaporator cooling coils to the inlet of a motor-driven multi-vane fan. The discharge air from the fan splits into four duct systems serving the four zones into which each floor is divided. To control the temperature in the four zones, reheat steam coils are installed in the discharge ducts.

Air is supplied to the room through Velocitrol air-registers, each of which serves approximately 400 sq ft. The outlets are 20 feet on centers.

A continuous duct along the long North Wall of each floor is installed for the return air. This duct is substantially constructed of stretcher levelled steel plate arranged so that the top can be used as a bench. This continuous duct is installed on this wall to avoid drafts due to infiltration in cold weather.

The refrigeration system uses Freon 12 and operates on direct expansion. Two compressors located in the basement discharge to evaporative shower type condensers located on the roof. From the condensers, the liquid refrigerant passes down through expansion valves into the cooling coils in the air supply duct for each floor. From the coils the refrigerant gas returns to the compressors completing the cycle.

The control system is completely automatic. There are four thermostats on each floor, one for each of the zones. The thermostats regulate the steam supply to the reheat coils to maintain constant temperature in the zones. The thermostats during the cooling season, operating through a cumulator, open or close in rotation the expansion valves on the four cooling coils of each floor.

The two compressors, each 4-cylinder 6 x 5 in., 485 rpm, operate from the cumulator, each compressor having three stages of capacity, 50%, 75% and 100%. The calculated total load of the building system is 83.5 tons.

On the second floor of the Gage Building there is a

room built with tile walls to which there are two entrances. Each entrance has a vestibule and an inner door. The room is 60 ft long by 40 ft wide and is centrally located so that none of its walls are adjacent to the main building walls. This is the Final Inspection Room.

Inspection Room System

The Final Inspection Room is separately air conditioned. In this room the dry bulb temperature is maintained at 68F with variations not exceeding ½F; relative humidity is maintained at 50% with variations not exceeding 3%, equivalent to ½F variation in wet bulb temperature.

In this room the final inspection of the finished product is made. The gages are brought into the room and allowed to stand for some time to allow the metal to reach the room temperature, after which the accurate measurements required in this operation are made.

The air condition of 68F temperature and 50% relative humidity is in accord with the recommendations of the Bureau of Standards, as well as being the recognized international standard at which all such work should be calibrated.

Five thousand cubic feet of air per minute is delivered to this room through six ceiling type Anemostats. The maximum temperature differential between entering air and room air is 6¼F.

A duct built of stretcher levelled steel plates around the walls exhausts the air uniformly from all the room. There is a complete air change in this room every six minutes.

Fresh air can be alternately taken from outdoors or from the *building* conditioning supply ducts. Fresh air and return air from the room combine in a plenum chamber and pass through an electrostatic air filter, then through an air washer and a heating coil into a motor-driven multi-vane fan, from where it is discharged through ducts and diffusers to the room.

Chilled water is pumped through the air washer. To control dew point and humidity, automatic control maintains this water at a constant temperature until there is a change in the relative humidity in the room and then a humidistat in the return air duct resets this control to a higher or lower temperature as required. Similarly, a control maintains constant dry bulb temperature in the air discharge by admitting steam to the reheat coil. A room thermostat resets the constant temperature control. Dry bulb temperature and relative humidity are continuously recorded on charts inside the room.

For cooling, water from the air washer is pumped through a water cooler in the basement and back to the air washer sprays. Part of the water is by-passed around the cooler and mixed with the chilled water in an automatically controlled three-way valve to maintain the desired temperature.

The water cooler is served by a motor driven 4-cylinder, 4¼ x 3 in. compressor operating at 550 rpm with water-cooled condenser.

Water from the condenser is discharged to the evaporative shower type condensers on the roof which serve the two compressors on the *building* system. Surplus water is discharged to the main roof for flooding. The maximum calculated heat load of the Final Inspection Room is 14.4 tons.

The air conditioning systems were designed by McClintock & Craig, Inc., Engineers and Architects of Springfield, Mass., who also designed the building itself and other services. The E. B. Howell Co., Hartford, Conn., installed the systems.

The refrigerating equipment used was furnished by Worthington Pump and Machinery Corporation; fans and air washer are by B. F. Sturtevant Company; automatic self-cleaning air filters by American Air Filter Company; electrostatic air filter by Westinghouse Electric & Manufacturing Company; control for the building system furnished and installed by Johnson Service Company, and that for the Final Inspection Room furnished and installed by Minneapolis-Honeywell Regulator Company, using Brown Instruments.

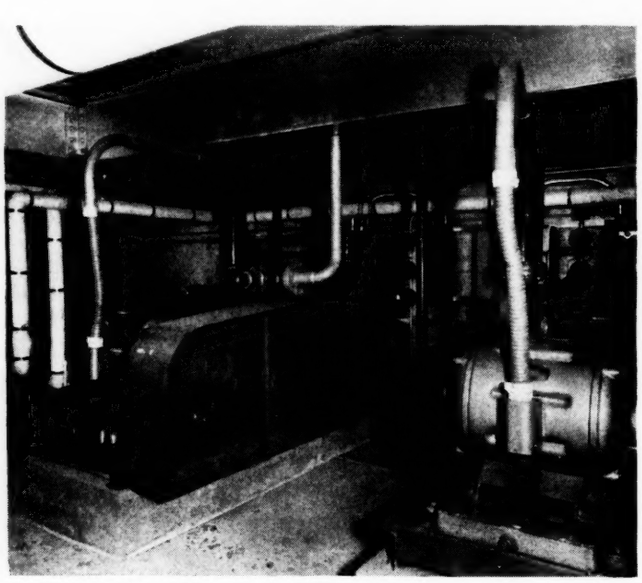


Fig. 4. Another view of the air conditioning machinery in the basement.

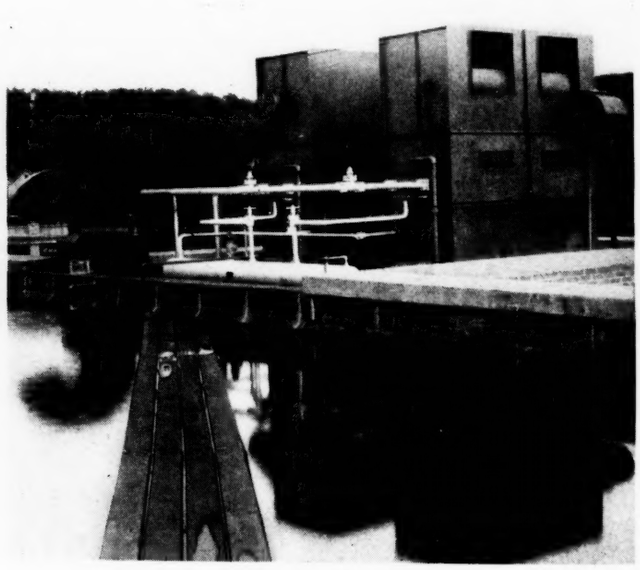


Fig. 5. A view of the flooded roof showing the condensers.

A view along the circumferential aisle of the East Buffalo Round House, Lehigh Valley Railroad.

LEHIGH VALLEY RAILROAD

saves $18,000 to $20,000 a year by installing unit heaters and low pressure boilers in its East Buffalo Round House. Three heaters supply heated air through ducts to pits†.

WHEN the East Buffalo Round House was originally built, a central heating system was installed to supply heat and steam pressure to several buildings —the round house, a large shop, storage and hoist sheds. The central heating system had four 300 hp high-pressure boilers. In addition to heating, it generated steam to supplement the built-in, forced-draft locomotive blowers when fires were started in the locomotive fire boxes.

About a year ago, the Lehigh Valley Railroad discontinued the use of these separate buildings and moved the shops used for repair, storage and heating into the round house building.

To heat it, two 125 hp Erie City low-pressure boilers were installed—replacing the four 300 hp high-pressure boilers of the old system. At the same time, forty Fedders unit heaters were installed in place of standard radiators.

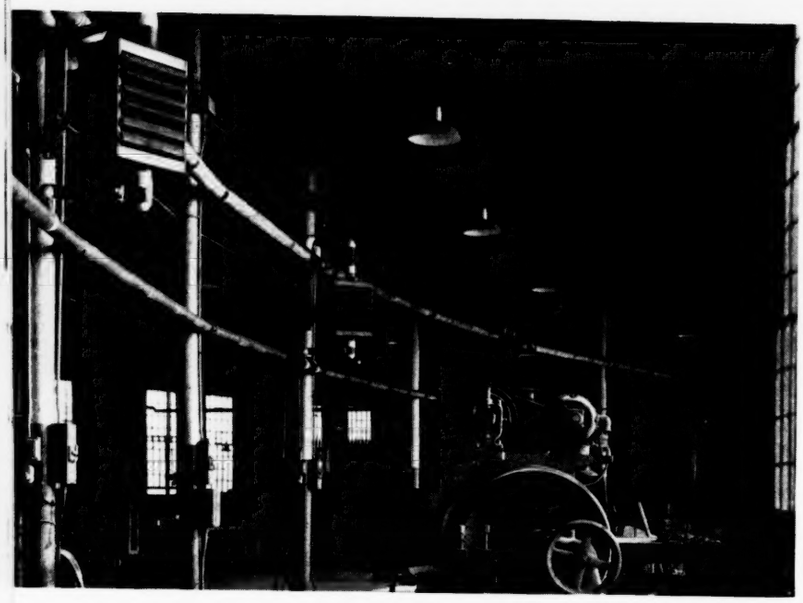
The round house now includes a machine shop, tool room, storage room, and oil room together with a large, 15 locomotive stall room. To heat this stall room, eighteen unit heaters are used. Seven unit heaters are located in the machine shop, three in the store room, one in the tool room, one in the oil room and seven in the hoist building.

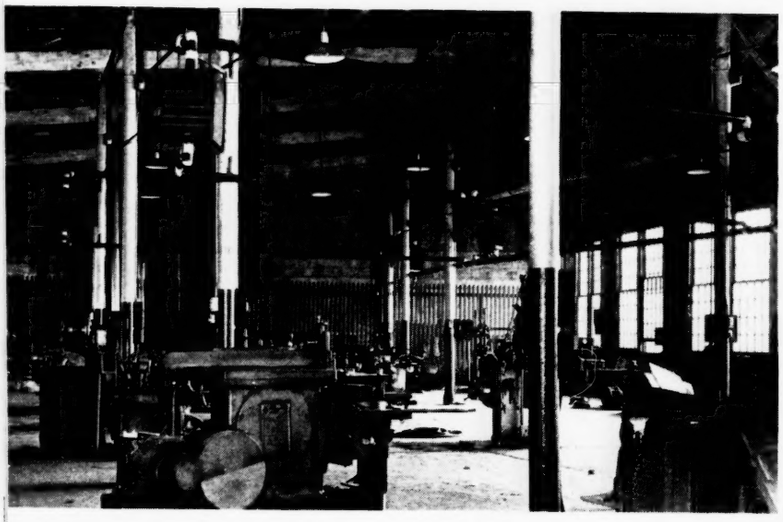
The two bottom photographs on the next page shows one of three unique applications of the unit heaters which supply heat to a bank of five pit stalls. The heat is forced from the unit heaters into ducts that run under the floors to the pits.

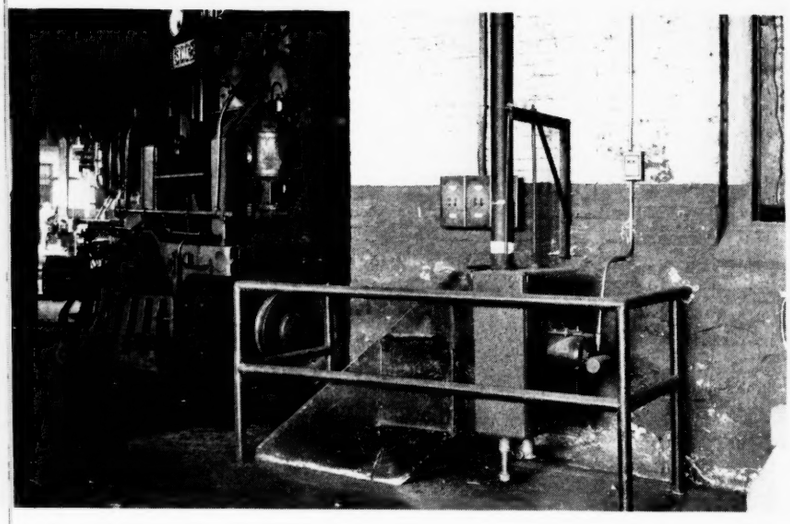
In the old system, where steam was used to supplement the forced-draft blowers in the locomotives, high pressure was a necessity. With the new installations, an electric blower, suspended from an I-beam and attached to the locomotive stack takes the place of steam Changing from four high-pressure blowers to two low-pressure blowers, and using unit heaters in place of indirect radiation has resulted in an estimated saving of $18,000 to $20,000 annually.

†This article is based on information supplied by John Kenyon, Supervisor of Bridges and Buildings for the Lehigh Valley Railroad.

PROFITS IN AIR







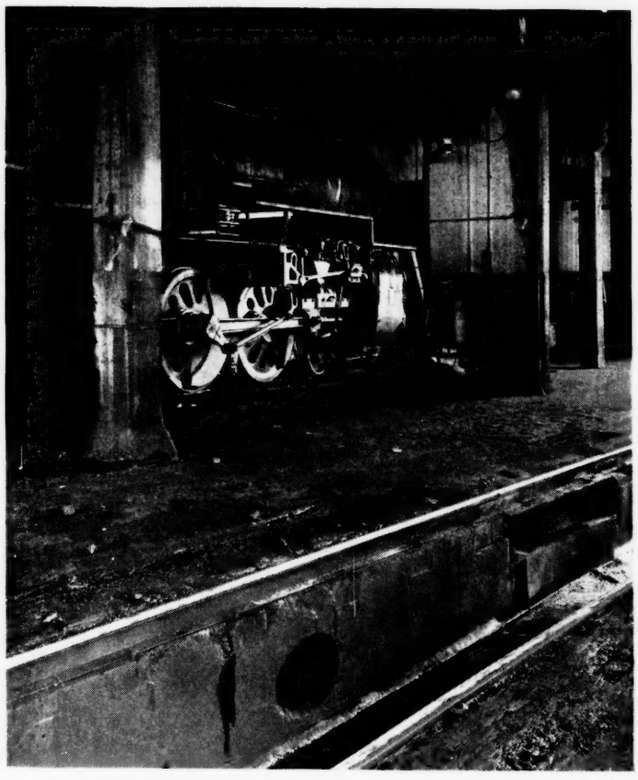
The two low-pressure boilers have to maintain only 4 to 5 pounds pressure which is a large saving. The Lehigh Valley Railroad has made a similar installation of Fedders heaters in its Suspension Bridge Round House at Niagara Falls, New York.

(Upper left) A view in the machine shop showing four of the seven unit heaters located in this department.

(Left center) Another view in the machine shop showing, at the left, two more of the unit heaters in this department.

(Lower left) One of the unit heaters which supplies heat to the pits through ducts under the floor.

(Below) Supply opening in one of the pits through which heat from one of the floor-mounted unit heaters is supplied.



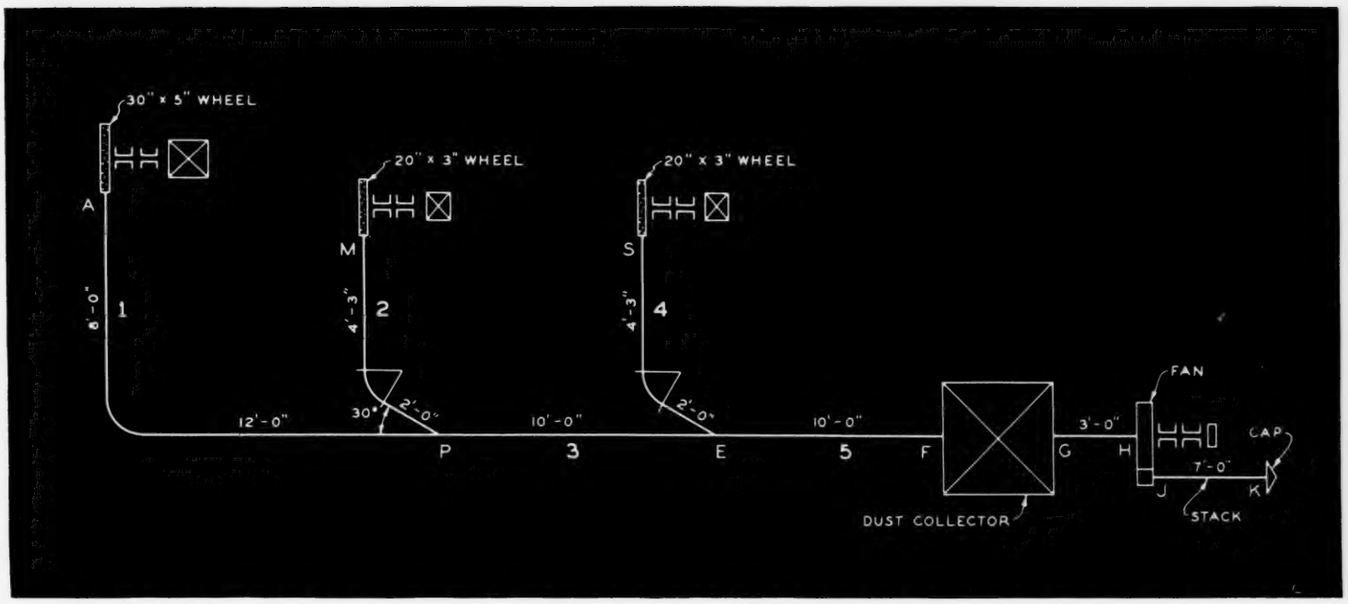


Fig. 1. A typical exhaust system for three grinding wheels. A rapid method of calculating pipe size, velocities, resistance and fan size required is given in this article.

Nomograph for Exhaust System Design

By B. KAGAN†

The author presents a nomograph for calculation of the resistance and the air volume in an exhaust or a blower system. The diagram facilitates especially the calculation of the air flow in a multiple branch system where the resistance in the intersecting points has to be balanced.

THE design of industrial exhaust systems is complicated by the fact that there is a large number of variables to take into consideration before such matters as the duct size, volume, and resistance can be determined. The resistance of any exhaust system varies with the kind of duct material, the size of the pipe, the length of the pipe and the square of the velocities. It is frequently necessary in exhaust system design, particularly with multiple branch systems, to resort to time-consuming trial-and-error methods.

To eliminate the use of these methods and to facilitate the design of exhaust systems the nomographic chart in Fig. 2 was prepared.

It will be noted that the lower section of the chart, consisting of scales D, L, and R, is devoted to the determination of the friction loss of the duct in terms of velocity pressure. Scale T is used to obtain the resistance in terms of inches of water while scale V converts this to velocity in feet per minute and velocity pressure in inches of water. Scale C shows the volume of air flowing in cubic feet per minute while scale D_1 gives the duct diameter in inches and area in square feet.

Problem

Perhaps the best way to show how the chart simplifies the problem of designing the exhaust system is to work out an actual problem.

Design an exhaust system for three grinders. The size of the grinder wheels and the lay-out of the grinders as shown in Fig. 1. Determine the size of the ducts and the required capacity (air volume, resistance and horsepower) of the fan.

Solution

STEP 1. DETERMINE SIZE, AIR VELOCITY, RESISTANCE AND AIR VOLUME IN BRANCH 1—DUCT AP (Fig. 3). In solving this problem it will be assumed that the plant is located in Illinois, therefore the requirements of the State Industrial Code will be followed.

According to the State Industrial Code, the minimum diameter of the branch pipe for a grinder wheel 30 in. in diameter and 5 in. thick is 6 in. Since the Code states the velocity of the air in the branch shall not be less than 4000 ft. per min., a 4100 ft. per min. velocity is selected for this branch. The orifice loss through the grinder hood is assumed as .65 VP_1.[1] (VP_1 is the velocity pressure in branch 1.) The length of the straight pipe in the branch AP is 20 ft. which is equal to 40 diameters of 6 in. diameter pipe.

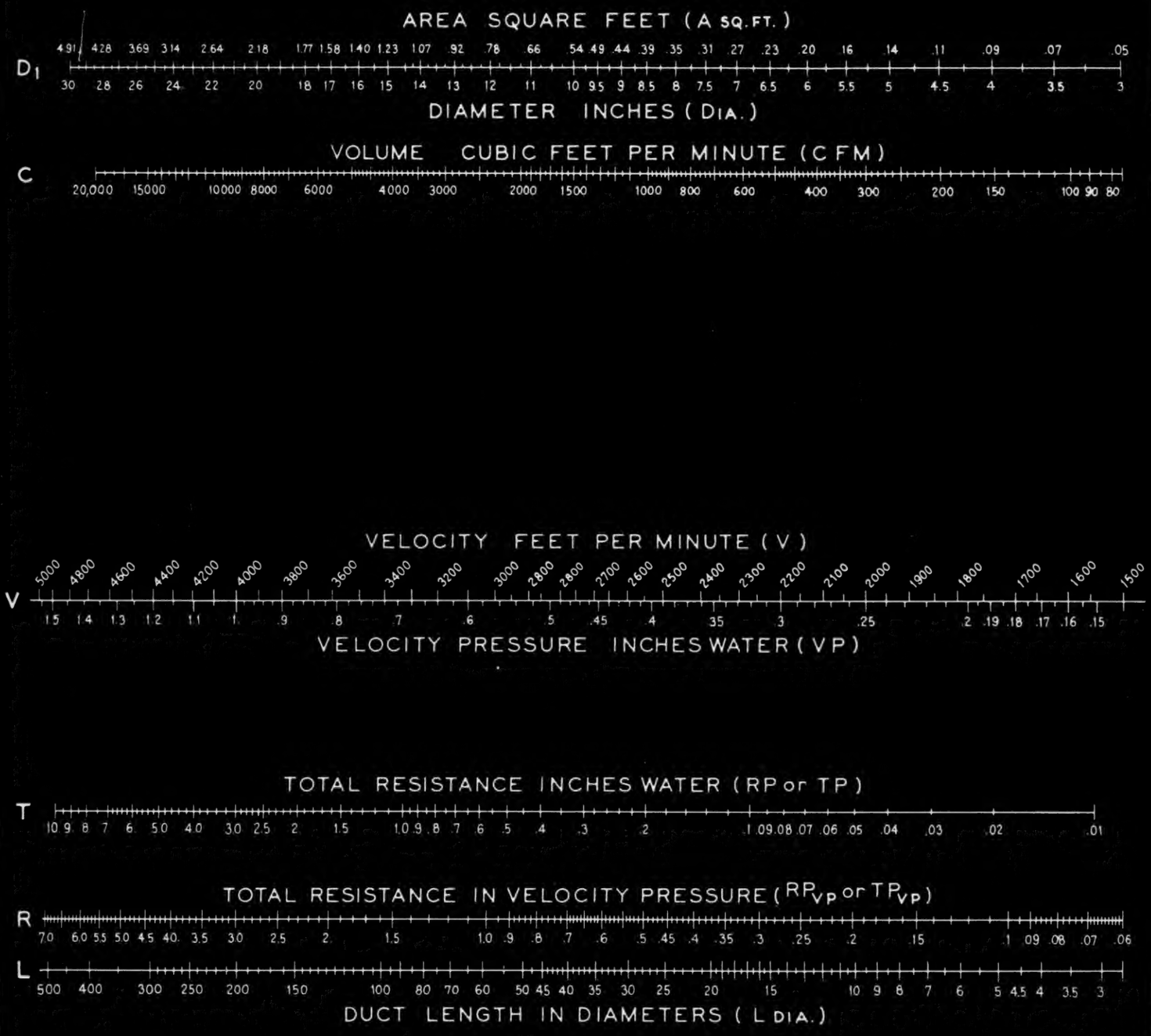
To determine the friction loss in terms of velocity pressure draw a line (1) from point 6 in. on scale D of the nomograph to the pipe length 40 on scale L.

This intersects the scale R at the point 0.78 which is the friction loss of this straight duct in terms of velocity pressure in branch 1 (VP_1).

To determine the total resistance (in terms of velocity pressure) of this branch, add the resistance of the straight pipe 0.78, the resistance of the orifice 0.65, and the resistance of the 90° elbow[1] 0.23. Thus the whole resistance (RP_1) is

$$RP_1 = (.78 + .23 + .65)\ VP_1 = 1.66\ VP_1$$

†Engineering Dept., Deere & Co., Moline, Ill.


AREA SQUARE FEET (A SQ.FT.)
D1
4.91 4.28 3.69 3.14 2.64 2.18 1.77 1.58 1.40 1.23 1.07 .92 .78 .66 .54 .49 .44 .39 .35 .31 .27 .23 .20 .16 .14 .11 .09 .07 .05
30 28 26 24 22 20 18 17 16 15 14 13 12 11 10 9.5 9 8.5 8 7.5 7 6.5 6 5.5 5 4.5 4 3.5 3
DIAMETER INCHES (DIA.)
VOLUME CUBIC FEET PER MINUTE (CFM)
C
20,000 15000 10000 8000 6000 4000 3000 2000 1500 1000 800 600 400 300 200 150 100 90 80
VELOCITY FEET PER MINUTE (V)
V
5000 4800 4600 4400 4200 4000 3800 3600 3400 3200 3000 2800 2800 2700 2600 2500 2400 2300 2200 2100 2000 1900 1800 1700 1600 1500
1.5 1.4 1.3 1.2 1.1 1. .9 .8 .7 .6 .5 .45 .4 .35 .3 .25 .2 .19 .18 .17 .16 .15
VELOCITY PRESSURE INCHES WATER (VP)
TOTAL RESISTANCE INCHES WATER (RP or TP)
T
10 9 8 7 6 5.0 4.0 3.0 2.5 2 1.5 1.0 .9 .8 .7 .6 .5 .4 .3 .2 .1 .09 .08 .07 .06 .05 .04 .03 .02 .01
TOTAL RESISTANCE IN VELOCITY PRESSURE (RPVP or TPVP)
R
7.0 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2. 1.5 1.0 .9 .8 .7 .6 .5 .45 .4 .35 .3 .25 .2 .15 .1 .09 .08 .07 .06
L
500 400 300 250 200 150 100 80 70 60 50 45 40 35 30 25 20 15 10 9 8 7 6 5 4.5 4 3.5 3
DUCT LENGTH IN DIAMETERS (L DIA.)
DIAMETER INCHES (DIA.)
D
30 28 26 24 22 20 19 18 17 16 15 14 13 12 11½ 11 10½ 10 9½ 9 8½ 8 7½ 7 6½ 6 5½ 5 4½ 4 3½ 3

← *Fig. 2. Nomograph for calculating exhaust systems. This chart will considerably reduce the amount of work involved in calculating exhaust systems particularly when there are multiple branches in the system.*

When we add to this value one velocity pressure (the pressure needed to accelerate the air from state of rest to the particular velocity VP = (V ÷ 4006)²) we get the total pressure of the branch at point P in terms of VP_1.

$TP_1 = RP_1 + VP_1 = 1.66\ VP_1 + VP_1 = 2.66\ VP_1$

To convert this pressure from terms of VP_1 to inches of water we use the scales R, T, and V.

Line 2 is drawn between point 2.66 (total resistance) on scale R, and point 4100 (air velocity) on scale V and intersects scale T at point 2.8. This is the total pressure in inches of water of the branch 1 at point P.

To determine the volume of air flowing scales V, C, and D_1 are used.

Line 3 is drawn from the velocity 4100 on scale V to the diameter 6 in. on scale D_1. This line intersects line C at point 800 c.f.m. which is the volume of air flowing branch 1.

Thus in branch 1 the pipe diameter is 6 in., the velocity 4100 ft. per min.; volume 800 c.f.m., and total pressure at point P, 2.8 in., W.G.

[1]For the value of losses in various types of elbows and orifice losses for different hoods see the article by F. F. Kravath, page 27, November, 1940, HEATING AND VENTILATING.

STEP 2. CALCULATE BRANCH 2—DUCT MP (Fig. 4).

For a 20 in. diameter, 3 in. thick grinder wheel, a 5 in. diameter pipe is called for by the Illinois Code. The length of the straight pipe is 6 ft. 3 in., or 15-pipe diameters.

To determine the friction loss in this pipe, line 4 is drawn from point 5 in. on scale D to point 15 on scale L. This intersects line R in the point .3, which is the friction loss for the straight pipe in terms of velocity pressure (VP_2). The resistance of the 60° elbow is taken as 0.18 of the velocity pressure (VP_2), the 30° entrance to the main as 0.2 VP_2 and the orifice as 0.65 VP_2. Adding these,

$RP_2 = (.3 + .18 + .2 + .65)\ VP_2 = 1.33\ VP_2$

The total pressure of the branch is found by adding to this one velocity pressure,

$TP_2 = RP_2 + VP_2 = 1.33\ VP_2 + VP_2 = 2.33\ VP_2$

Since the fan must maintain the same static pressure for both branches we have now to find for branch 2 a velocity which will create at point P a pressure of 2.8 in. W.G. which was the calculated pressure from step 1 at point P.

$$2.33\ VP_2 = 2.8 \text{ in. W.G.}$$

We find this velocity with the aid of the scales R, T, and V.

Line 5 is drawn from point 2.33 VP on scale R through point 2.8 in. W.G. on T and intersects scale V at point 4400 ft. per min., the required velocity in branch 2.

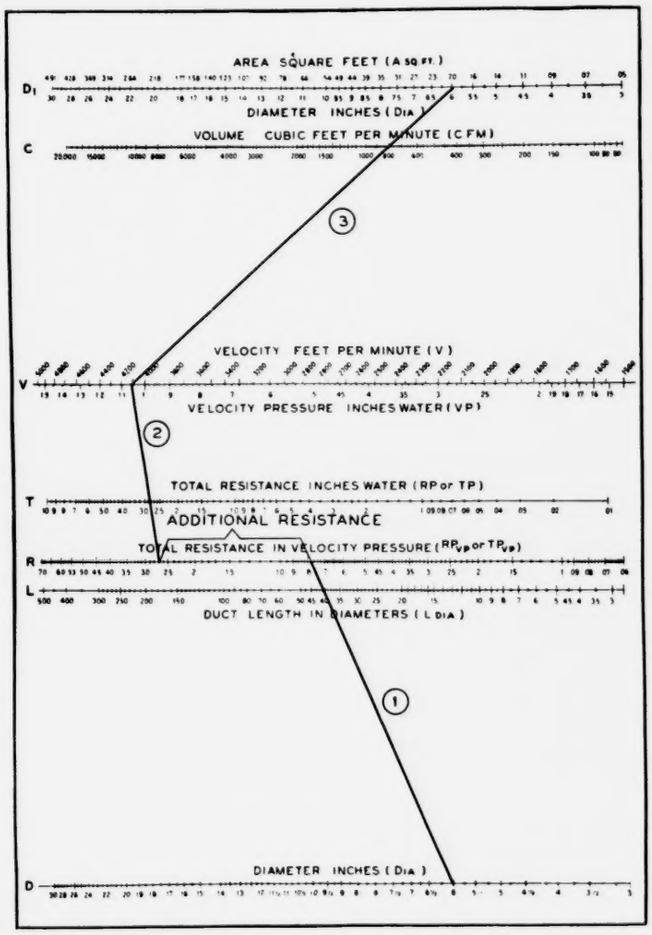

AREA SQUARE FEET (A SQ FT.)
DIAMETER INCHES (DIA.)
VOLUME CUBIC FEET PER MINUTE (CFM)
VELOCITY FEET PER MINUTE (V)
VELOCITY PRESSURE INCHES WATER (VP)
TOTAL RESISTANCE INCHES WATER (RP or TP)
ADDITIONAL RESISTANCE
TOTAL RESISTANCE IN VELOCITY PRESSURE (RPvp or TPvp)
DUCT LENGTH IN DIAMETERS (L DIA.)
DIAMETER INCHES (DIA.)
1
2
3

Fig. 3. Calculations for Branch 1—Duct AP.

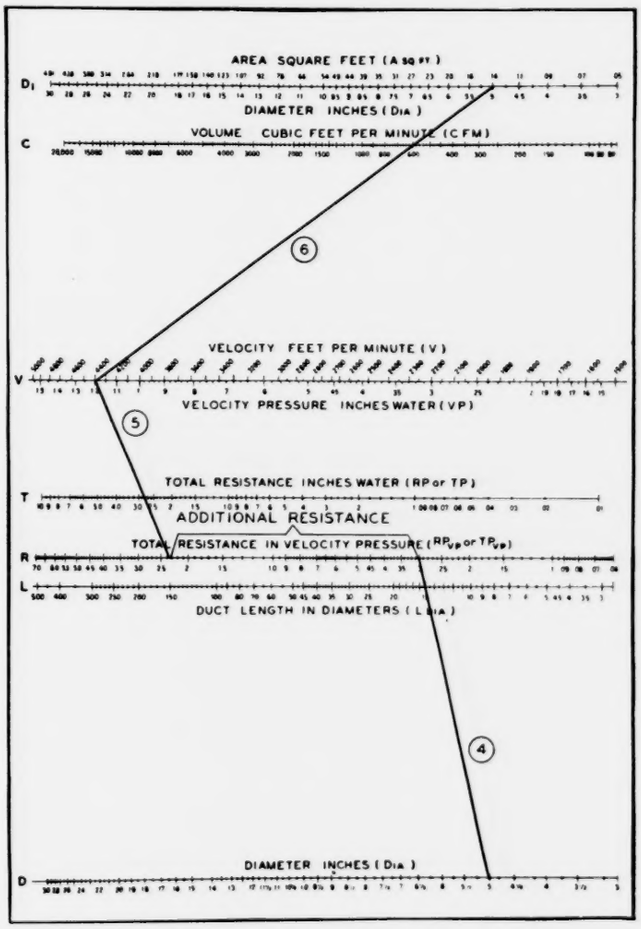

AREA SQUARE FEET (A SQ FT.)
DIAMETER INCHES (DIA.)
VOLUME CUBIC FEET PER MINUTE (CFM)
VELOCITY FEET PER MINUTE (V)
VELOCITY PRESSURE INCHES WATER (VP)
TOTAL RESISTANCE INCHES WATER (RP or TP)
ADDITIONAL RESISTANCE
TOTAL RESISTANCE IN VELOCITY PRESSURE (RPvp or TPvp)
DUCT LENGTH IN DIAMETERS (L DIA.)
DIAMETER INCHES (DIA.)
4
5
6

Fig. 4. Calculations for Branch 2—Duct MP

The air volume in this branch is found by drawing line 6 from point 4400 ft. per min. on V to pipe diameter 5 in. on D_1. This crosses scale C at point 600 c.f.m. which is the air volume needed in branch 2.

Summing up in branch 2, the pipe diameter is 5 in.; the velocity 4400 ft. per min.; the air volume 600 c.f.m.; and the total pressure is 2.8 in. W.G. at point P.

The preceding two steps illustrate one of the important advantages of the nomographic chart. In most methods of exhaust system design, as for example, in the American Foundrymen's Association Code, it is recommended that each new pipe velocity in a multiple branch system be determined by trial. With these methods several velocities must be tried before the total pressure in each branch is made approximately equal. As a matter of fact, the American Foundrymen's Code recommends the pressure in the pipe intersections be kept within $\pm$ 2.5%.

With the aid of this nomograph it is possible to determine, without trial, the correct velocity in each of the intersecting branches so that the pressures in the branches are exactly equal.

Another advantage of the chart is shown by the following brief example. The velocity in branch 1 was set at 4100 ft. per min., while the velocity in branch 2 was found to be 4400 ft. per min. If it is desired to change the velocity in branch 1 to 4000 ft. per min., the pressure at point P will be changed from 2.8 in. to 2.66 in. This is found by drawing a line between 2.66 on R and 4000 on V and reading 2.66 on T. The velocity in branch 2 will be found to be 4300 ft. per min. (Intersection of scale V with the line between point 2.33 VP on R and point 2.66 in. on scale T.)

Thus the chart spares long recalculations when the velocity is changed.

STEP 3. CALCULATE MAIN 3 (DUCT PE).

The volume of air in the duct PE is 1400 c.f.m., the sum of the 800 c.f.m. from branch 1 and 600 c.f.m. from branch 2. If a velocity of 3600 ft. per min. is selected, line 7, drawn from the point 1400 c.f.m. on scale C to the point 3600 ft. per min. on V, intersects scale D_1 at 8.5 in. This is the required diameter for the duct PE. The length of the duct is 10 ft., 0 in., or 14-pipe diameters of 8.5 in. diameter pipe. To find the friction loss in terms of velocity pressure (VP_3), line 8 is drawn from 8.5 in. on scale D to 14 diameters on scale L. This line intersects scale R at 0.25 which is the resistance in terms of velocity pressure.

To determine the resistance in inches of water, line 9 is drawn from .25 on R to 3600 on scale V. This intersects scale T at 0.2 which is the resistance in terms of inches of water.

By adding .2 in. W.G. to the total pressure 2.8 in. W.G. at point P we get the total resistance as 3.0 in. W.G. at point E.

Summing up for main 3 the pipe diameter is 8.5 in.; the velocity 3600 ft. per min.; the volume 1400 c.f.m., and the total pressure 3.0 in. W.G. at point E.

STEP 4. CALCULATE BRANCH 4 (DUCT SE).

The diameter of this pipe is 5 in., the same as the diameter of branch 2. With the aid of the scales D, L, and R the friction loss of straight pipe is determined

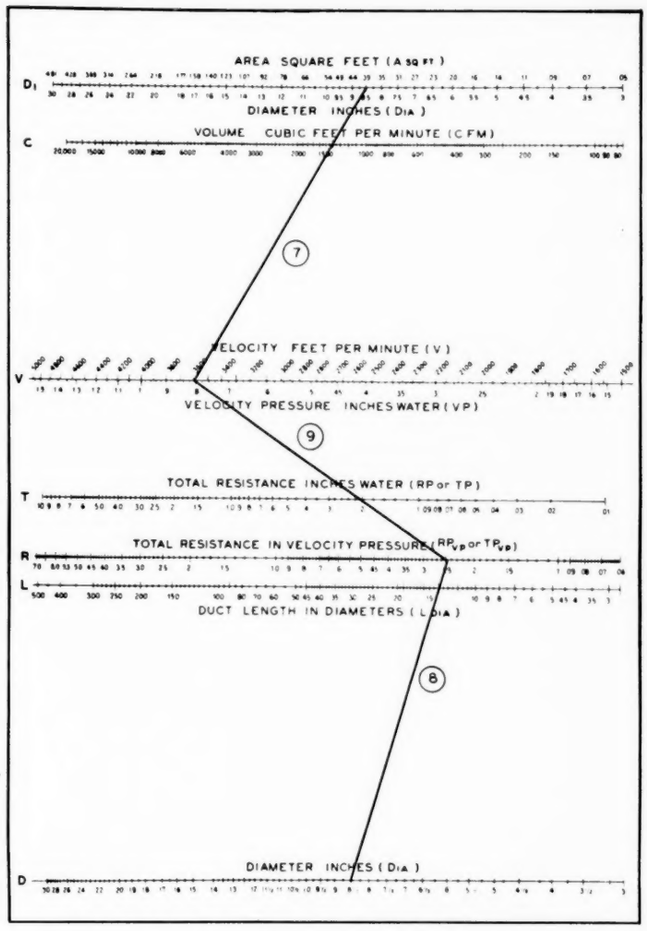


Fig. 5. Calculations for Main 3—Duct PE.

in terms of velocity pressure. (Line 10.) By adding the resistance of the elbow, entrance, orifice loss and one velocity pressure for velocity head we find the total pressure in terms of velocity pressure for this duct. In this example the value is the same as in branch 2.

$$TP_4 = 2.33\ VP_4$$

The total pressure has to be 3.0 in. W.G.—the total pressure at the point E from the calculation in step 3. It is now necessary to determine the velocity in the branch 4 which will create a velocity pressure of 3.0 in. W.G. at the point E.

This velocity is found by drawing line 11 from the point 2.33 on scale R to the point 3.0 in. on scale T. This line intersects line V at 4520 ft. per min. which is the required velocity.

To determine the volume of air in branch 4, line 12 is drawn from 4520 on scale V to 5 in. on D_1. This line crosses scale C at 630 c.f.m. which is the air volume.

Summing up in branch 4, the pipe diameter is 5 in.; the velocity 4520 ft. per min.; the volume 630 c.f.m., and the total pressure 3.0 in. W.G. at point E.

STEP 5. CALCULATE MAIN 5—DUCTS EF, GH, JK (Fig. 7).

The volume in this duct is 1400 + 630 = 2030 c.f.m.

Assume a velocity of 3500 ft. per min. in this main. Line 13 drawn from 3500 on V to 2030 on C indicates on scale D_1 that the diameter should be 10.4 in. If a 10.5 in. diameter duct is used, the velocity will be 3400 ft. per min. (The point where line 14 drawn be-

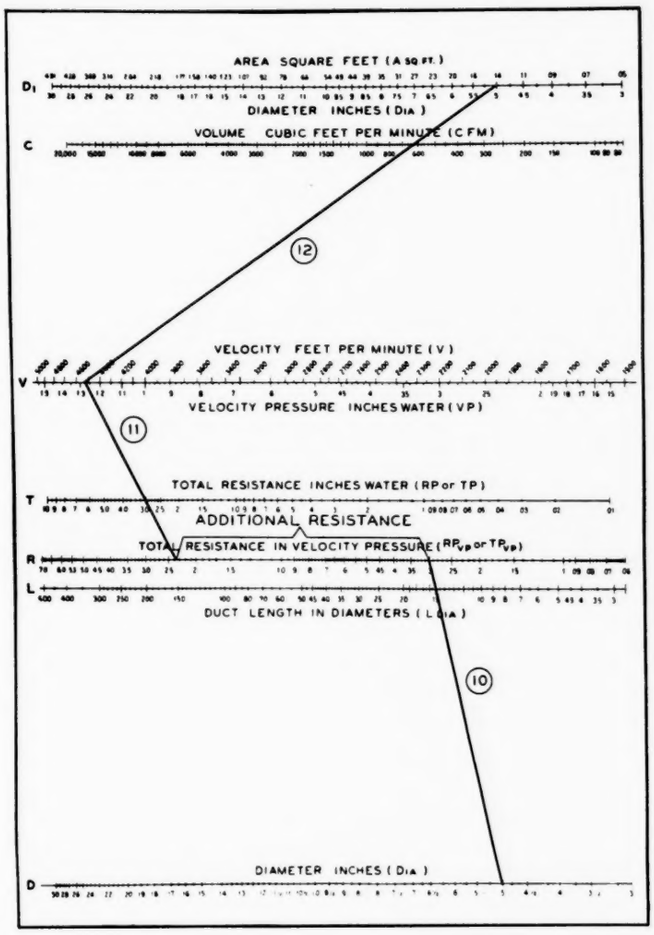


Fig. 6. Calculations for Branch 4—Duct SE.

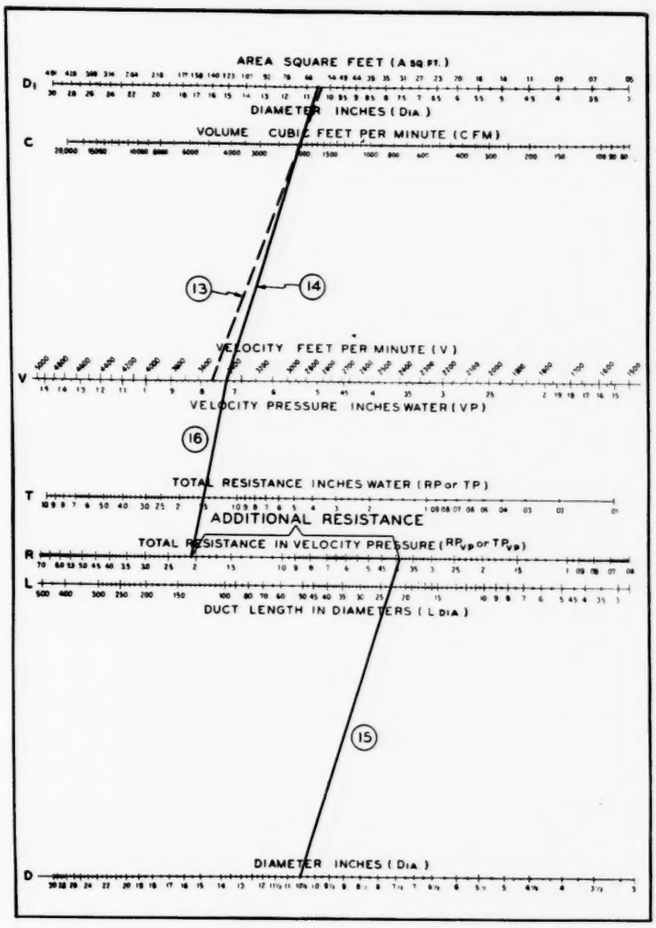


Fig. 7. Calculations for Main 5—Ducts EF, GH, JK.

tween point 1400 on C and point 10.5 on D_1 intersects scale V.)

The straight pipe length in sections EF, GH, JK is 20 ft., 0 in., or 23 diameters of 10.5 in. diameter pipe. The friction loss for this length is .39 VP. (Point where line 15 drawn from point 10.5 in. on D to 23 on L intersects scale R.)

By adding 1.51 VP for the resistance in the dust collector and .2 VP for the loss in the stack cap we get the whole resistance in the main 5.

$$RP_5 = (.39 + 1.51 + .2)\ VP_5 = 2.1\ VP_5$$

At 3400 ft. per min. velocity, 2.1 VP equals 1.5 in. W.G. Line 16 drawn from point 2.1 on R to point 3400 on V intersects scale T at 1.5 in. W.G., which is the resistance in inches of water. This 1.5 in. W.G. resistance is added to the 3.0 in. W.G. resistance at point E to find the total resistance of the system 4.5 in. W.G.

The capacity of the fan should be therefore 2030 c.f.m. at 4.5 in. W.G. total pressure.

The power required to operate the fan will be

$$\text{hp.} = \frac{\text{c.f.m.} \times \text{TP}}{6356 \times \text{ME}} = \frac{2030 \times 4.5}{6356 \times .6} = 2.4 \text{ hp.}$$

when ME, mechanical efficiency, is assumed as 60%.

For convenience and clearer picture of the air flow in the system all calculation data are shown in Table 1.

Duct Resistance

In conclusion it should be noted that the friction loss of a straight pipe varies not only with the length of the pipe, the pipe size, but also with the kind of duct material and the smoothness of the duct interior.

Scale D in the nomograph is designed for ducts of galvanized steel with a smooth interior. For ducts of black sheet metal the resistance will be 10% higher than the values determined from the nomograph.

TABLE 1

Duct No.	Dia. Inch	Length		Resistance in Terms VP						Veloc. F.P.M.	Volume C.F.M.		Resist. In. W.G.	
		Feet	Diam.	Strght	Elbow	Entr.	Orif. L.	Vel. Hd	Total		Branch	Main	Branch	Main
1	6	20'-0"	40	.78	.23	..	.65	1.0	2.66	4100	..	800	..	2.8"
2	5	6'-3"	15	.3	.18	.2	.65	1.0	2.33	4400	600	..	2.8"	..
3	8.5	10'-0"	14	.25	..	..	..	..	.25	3600	..	1400	.2"	3.0"
4	5	6'-3"	15	.3	.18	.2	.65	1.0	2.33	4520	630	..	3.0"	..
5	10.5	20'-0"	23	.39	Coll.	1.51	Cap .2	..	2.1	3400	..	2030	1.5"	4.5"

The Present Situation in Priorities as They Affect Heating and Air Conditioning

To assure supplies to the vital defense industries, President Roosevelt authorized the Priorities Division of the Office of Production Management to determine what quantities of each material was available, turn over whatever amounts were required to defense industries, and ration the balance as fairly as possible to ordinary civilian business. Today, approximately one year after formation of the Priorities Division, 15 materials are under its direct control, 14 are under a milder form of inventory control and the Army and Navy have a Critical List of 300 items over which these Armed forces have prior rights. Here reviewed in the priority situation as it affects heating, ventilating and air conditioning.

ONE hundred representatives of the air conditioning industry and some 300 heating equipment representatives left Washington, following meetings on July 16-17, asking themselves such questions as these:

What will priorities control mean to my defense contracts?

What will they mean to my ordinary civilian volume?

If I can't get sufficient raw materials, what then?

The meetings, called by Joseph L. Weiner, Assistant Administrator of the Office of Price Administration and Civilian Supply in charge of the civilian supply allocation division, were part of a series in which representatives of eight industries were called to Washington to report on raw material needs and the most suitable methods of making necessary curtailments.

While no report of the results of the air conditioning or heating equipment meetings are contemplated until industry committees have been formed to make recommendations, results of three other industry meetings gives a cue as to what may be expected:

The automobile industry, already accepting a cut of 20% in production for 1942, was told to prepare for a cut to 50% of its present output;

Household mechanical refrigeration will be limited to a maximum monthly production of 150,000 units;

Production of domestic mechanical washing and ironing machines will be cut 30%.

Metal furniture and furnishings, cooking stoves and ranges, and miscellaneous household appliances, the other three classifications involved in the meetings, also heard the following themes stressed by Assistant Administrator Weiner:

1. Manufacturers of consumers' durable goods requiring raw materials, principally metals, in great demand for the defense program, face increasing shortages and must be prepared to curtail their output for non-defense purposes.

2. Every effort should be made by such manufacturers to obtain defense contracts or subcontracts to avoid personnel lay-offs with resultant hardship to families of employees, local merchants and others dependent upon the affected factories' payrolls.

3. Substitute materials should be adopted wherever possible. In this connection manufacturers were cautioned not to substitute a metal or other substance that already is in large, but not yet critical, demand for defense.

The Office of Price Administration and Civilian Supply, familiarly known as Administrator Leon Henderson's OPACS, enter the priorities picture to administrate "residual supplies" to civilian industries after Edward R. Stettinius' Priorities Division of OPM has satisfied the demands of those supplying defense needs. In other words, OPACS is to distribute supplies, if any, in such amounts as the importance of the industry to civilian welfare may dictate.

Briefly stated, defense requirements get an "A" rating from the Priorities Division of OPM; civilian requirements get a "B" rating on residual supplies from OPACS.

With the defense program barely started, and with Russia and South American countries joining Great Britain in clamoring for Lease-Lend allotments, there is a serious question whether there will be any supplies—any appreciable civilian residual supplies of increasingly large numbers of critical materials.

Joseph L. Weiner, Assistant Administrator of the office of Price Administration and Civilian Supply.

Today there are 15 items which cannot be secured in this country without the permission of the Priorities Board in Washington. These are: aluminum, magnesium, nickel, nickel-steel, ferro-tungsten, tungsten high-speed steel, machine tools, synthetic rubber, copper, cork, borax, polyvinyl chloride, zinc, rubber, and chromium.

In addition to the foregoing, which are under industry-wide mandatory control, the Priorities Division exercises a mild form of inventory control over the following metals and classes of metals: ferrous alloys, all types; iridium; lead and steel products, including rolled,

drawn forgings, castings, pig iron; lead; manganese or spiegeleisen; mercury; nonferrous alloys, all types; tin; vanadium; and secondary materials, or scrap, containing any of the metals listed above.

This form of inventory control requires suppliers of these metals, in semi-processed or pre-manufactured form, to file a statement of compliance once with the Priorities Division, and also requires customers for these metals in semi-processed or pre-manufactured form to file monthly statements of compliance with their suppliers.

These monthly statements declare that the customer has not received, during the previous calendar month, any deliveries of the specified materials which increase his inventories of the quantities necessary, on the basis of his usual method and rate of operation, to meet his required deliveries efficiently.

Steel in Special Class

The General Steel Preference Delivery Order is designed to assure the fulfillment of defense orders ahead on non-defense orders. It provides that a customer for iron and steel products who is unable to place an order satisfactorily, or who has his order unduly delayed, may bring this to the attention of the Priorities Division on a special form. The Priorities Division will then require the supplier involved to explain the delay or the rejection.

Upon the basis of information thus obtained, the OPM will take whatever action is necessary to expedite the delivery of iron and steel products for defense or essential civilian requirements.

Priorities Critical List

In addition to the 29 items controlled directly by the Priorities Division, the Priorities Critical List contains approximately 3000 items and classes of items (most of them military in character but some of them raw materials) on which Army and Navy orders can automatically be given priority. This List is maintained by the Priorities Division so that an authorized Army or Navy contracting officer, in awarding a contract for any of the items listed, may assign a preference rating to that contract if this is necessary in order to obtain the desired material in the necessary quantities and on the required delivery dates. Although some of the items are under industry-wide control, most of them are subject to control only in the sense that Army and Navy orders can automatically be granted priority.

Defense Comes First

The fact that defense needs will be taken care of before civilian needs are seriously considered provides the answer to the heating and ventilating industry's first question—"What will priorities control mean to my defense contracts?"

Materials will be made available, when proper procedure is followed, for any heating or ventilating equipment being planned, manufactured or contracted for delivery to a defense project of any type. This is meant to include actual delivery to the Army, Navy or Maritime Commission; to plants being constructed or enlarged to meet defense requirements; to defense housing projects, and to the Government under ordinary procurement procedure.

Four plans are announced by the Priorities Division to assure delivery of materials or finished products for defense-connected purposes: blanket ratings, project ratings, individual priorities certificates, and the defense supplies rating plan.

Limited blanket ratings can be given to a company or companies engaged almost wholly in defense work. Such an order assigns a company one rating which applies to all its contracts or orders for specified scarce materials *flowing into defense production.* So far, blanket ratings of this type have been given only to (1) machine tool and gage builders; (2) crane builders; (3) certain producers of military planes, engines and propellers; (4) producers of railroad freight cars; and (5) builders of merchant ships under the Maritime Commission program. Additional ratings of this type will be issued when necessary.

Project ratings are somewhat similar to limited blanket ratings except that they apply to a project—such as a munitions plant, a power plant or a dam. So far the Priorities Division has issued over 65 project ratings.

In addition to the general classification of project ratings, a plan has been worked out jointly with the Defense Housing Coordinator, Charles F. Palmer, to grant priority status to certain defense housing projects and programs. A new "defense housing critical list" is being developed. The general purpose of this plan is to put specified defense housing activities in a preferential class and thus assure the prompt flow to these projects of critical building materials.

Individual Certificates can be issued to a manufacturer or businessman who has difficulty in obtaining supplies, whether or not his production is purely defense, *if his work is important to defense.* Individual preference rating certificates, however, are in the majority of cases issued under the Priorities Critical List by Army and Navy contacting officers. Records of the Army and Navy Munitions Board indicate that about 266,000 certificates and extensions of certificates have been issued by contractors of the armed services to date. The Priorities Division itself has issued about 9000 individual preference rating certificates.

Stressed is the fact that these individual preference certificates cover only a specific item or items needed for a specific contract. Unlike the priority plan that functioned during World War I, the 1941 priorities apply to commodities only, with no provision for priority numbers of ratings on behalf of firms.

The Defense Supplies Rating Plan has been developed to meet the problem of some defense manufacturers who, because they must start production in advance of receiving defense orders, must have aid to secure a steady flow of materials into their plants. This plan would seem to apply to manufacturers of stocks of heating and ventilating equipment for "off the shelf" delivery when defense needs (camps, cantonments, housing projects, etc.) develop.

This plan provides for the granting of a preference

rating (A-10) to manufacturers who can clearly identify the proportion of their production which is defense work. The A-10 rating applies only to the defense work. Thus a manufacturer who might be engaged 75% in defense work, can, if he meets all the requirements, get a preference rating which he may apply to deliveries of 75% of his required materials. So far nearly 100 firms have been granted the use of this plan.

Contractors or dealers requiring stock for delivery to defense projects may facilitate deliveries by urging manufacturers to take advantage of this plan as a means of replacing raw materials represented by off-the-shelf deliveries.

A Maintenance and Repair Rating Plan is soon to be announced by the Priorities Division to assure delivery of materials and equipment, both defense and civilian, from unnecessarily depreciating during a period when replacement with new equipment may prove difficult.

Priorities Procedure

When difficulty is experienced in getting deliveries of raw materials or finished products *for defense purposes*, there are three general rules to follow:

1. Seek the assistance of the governmental agency or contracting officer most directly interested in the order in question.
2. Apply for relief to the nearest Priorities Division branch office. (Such branches are located in Federal Reserve Cities. A list of those established to date appears elsewhere in this article).
3. Apply for relief to the Priorities Division, Office of Production Management, Washington, D. C., requesting Form PD-1.

During the first half of 1941, the Priorities Division has put increasing emphasis on four points:

1. Education—No amount of policing can take the place of understanding cooperation, freely and willingly given.
2. Inventory control—Excess inventory buying often makes full priority control necessary before it would otherwise be required.
3. Scheduling—Proper scheduling is the heart of any sound priority system, and materials should be ordered for delivery when they are required, not before.
4. Substitution—Critical materials are going to become even scarcer in the future and non-defense producers must switch over to less scarce materials as promptly as possible.

Producing for Civilian Needs

Point Four of the above code, the stress placed upon substitution, provides somewhat of an answer to the heating and ventilating industry's second question: "How will priorities affect my civilian business?"

To the extent that the industry can devise substitutes for any needed materials among the 15 items now under mandatory control or the 14 items under inventory control, manufacture of equipment for non-defense purposes can continue without interruption. Where needs conflict with those of the defense program, however, the outlook is none too bright. It may be assumed that all items on the mandatory list are "tight" and will become tighter. Too, the list can reasonably be expected to be increased as the defense program progresses.

A Priorities Division suggestion to the heating and ventilating industry is that substitutes be developed immediately wherever galvanizing is now employed, or where quantities of copper or cork are required. Zinc, required in galvanizing, is now nearly 300,000 tons short of requirements for defense purposes; copper is 350,000 tons short, and cork, available only from Portugal, is now sufficient for only three months' defense needs.

It is suggested that it may be necessary to substitute black sheet steel for galvanized types. The situation on sheet steel is not considered critical at present, but plates, forgings and structural steel are reported as "tight."

The vital importance of developing substitute materials immediately is hinted at by OPACS Administrator Henderson, as follows:

"Guns, tanks, airplanes and ships are built of the same basic materials as automobiles, washing machines, electric toasters, and household appliances. It is becoming evident now that the amount of copper, steel, aluminum, nickel, zinc, chromite, manganese and a number of other materials required for armaments is going to be so great that we won't have enough left over for consumers' durable goods. This means, rationing, not by cards at the stores but at the raw material line, and rationing means that someone is going to get hurt."

Priorities Division officials are urging all industries to take a long view of the priorities situation, figuring not in terms of deliveries next week or next month, but in terms of what to do over a period of years.

Administrator Henderson's statement brings the heating and ventilating industry face to face with a problem that is admittedly causing great concern in Washington, but one the Administration believes must be left to work itself out *after* defense needs have been met. It is admitted that some industries, their employes and their dealer outlets are in for trying times, but it is felt that alert members of the industry will be able to cushion expected blows to some extent by quick recognition of the problem and by taking two protective steps:

1. Development of substitutes.
2. Securing a backlog of defense business.

The backlog of defense business, it is explained, may be entirely foreign to the type of work the industry is new engaged in, but an immediate survey should be made by each plant or subsidiary, to determine whether there is some niche into which its particular equipment, experience, or skills might be fitted.

Manufacturers and operators of any type of equipment that might be adapted to defense needs are being urged to contact branch offices, in Federal Reserve Cities, of the Defense Contract Service, Office of Emergency Management. Attention of engineers likely to be negatively affected by the "defense first" program is directed to the Civil Service Commission's need for skilled technicians of all types.

ABSTRACTS of Current Papers, Books and Pamphlets

Trane Air Conditioning Manual

The new addition of The Trane Air Conditioning Manual contains, in addition to the material in older editions, an entirely new chapter on ducts and fans.

The chapter contains a comprehensive treatment of the subject in the same clear and logical style which made the earlier editions noteworthy. Because of the importance of a knowledge of the characteristics of fans and the design of ducts, this edition should make the book more valuable than ever for the air conditioning engineers.

Among the subjects treated in this chapter are: Measurement of Air Pressures in Ducts; Total, Static, and Velocity Pressure; Blower Fans; Propeller Fans; Fan Performance Curves; Fan Horsepower; Fan Efficiency; Selection of Fans; Computing Friction Loss in Ducts; System Characteristic Curves; Combination of Fan Performance and System Characteristic Curves; Horsepower Limiting Characteristics of Fans; Parallel Operation of Fans; Change in Duct Friction Loss with Change in Specific Volume of Air; Designing Duct Work, and Friction Losses in Elbows.

For those readers who are as yet unacquainted with this book, it may be said that it contains an unbiased practical treatment of the fundamentals of air conditioning. Chapter headings are: Heat; Comfort; Heat Gains; Properties of Air and the Psychrometric Chart; Calculations for the Conditioned Air Supply; Refrigerating for Air Conditioning; Water for Air Conditioning; and, Ducts and Fans.

[*"Trane Air Conditioning Manual." Published by The Trane Company, La Crosse, Wis. Cloth bound; 9 x 11½ in.; 376 pages. Available from the Trane Company, La Crosse, Wis. Price, $5. Duct and Fan Chapter only, $1. Holders of earlier editions can purchase this chapter for special price of 50 cents.*]

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BRIEF REVIEWS

Sun Heat. A reprint of parts 4 and 5 of a series of articles by Professor C. O. Mackey and L. T. Wright, Jr., of the Sibley School of Mechanical Engineering at Cornell University on "Estimating Heat Flow Through Sunlit Walls." These articles were originally published in Heating and Ventilating. The first three articles, collected in a previous reprint, set forth a rational method of determining the contribution to the cooling load of solar radiation and air temperature differences at different hours of the day, as applied to walls facing north, east, south, and west. The two parts in the new reprint present graphs and tables for walls facing northeast, southeast, southwest, and northwest, and also compare the results of the Mackey and Wright method with those obtained from methods previously employed. Materials considered are brick, masonry, concrete, and wood frame with various types of insulation. [*"Estimating Heat Flow Through Sunlit Walls, Parts 4 and 5," by C. O. Mackey and L. T. Wright, Jr. Reprint No. 14. Published by the Engineering Experiment Station. Cornell University, Ithaca, N. Y. Paper cover; 8½ x 11 in.; 8 pages. Available on request from the Engineering Experiment Station.*]

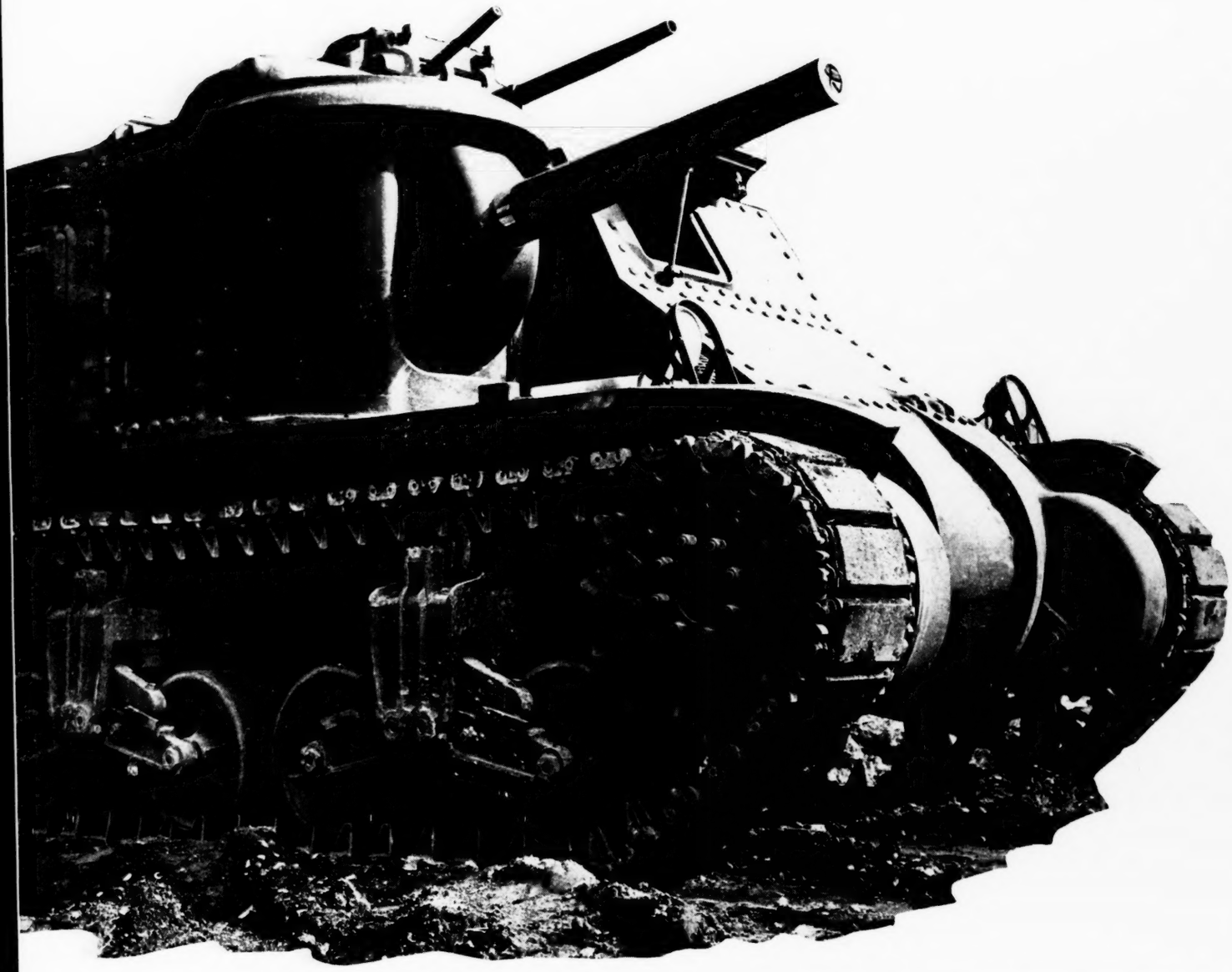
Business Records. 4th edition of this pamphlet which was first published in 1937. This pamphlet is designed to fit the needs of a busy executive who wants to hand over to his subordinates the problem of preserving records and storage space. It supplies the answers to the following questions which he will immediately ask: (1) Why should business records be preserved? (2) What materials should be selected for preservation? (3) How should records be preserved? (4) When should preservation be undertaken? It sets up a schedule which can be put into effect economically by most firms to preserve their most important records. It also contains a discussion of the current practices of such firms as an advertising agency, a bank, a department store, two public utilities, a railroad, and several types of manufacturing concerns. [*"The Preservation of Business Records," by Ralph M. Hower. Published by the Business Historical Society, Inc., Baker Library, Soldiers Field, Boston, Mass. Paper cover; 6 x 9 in; 56 pages. Available from the above Society on request.*]

Climate and Defense. A discussion of effect of climate on the efficiency and comfort of military personnel with particular reference to the climate of the western hemisphere. Gives numerous suggestions on the method of training to adapt troops to widely varied climatic conditions. [*"Climate and Efficiency of Military Personnel" by Charles I. Singer. Published in the Bulletin of the American Meteorological Society, May, 1941, pages 191-197. Single copies, 35 cents, from Robert G. Stone, Editor, Department of Engineering, New York University, University Heights, New York.*]

Fuel Conservation. This booklet points out 82 methods of conserving fuel for defense without sacrificing either comfort or health and shows how these fuel savings help actually to give a better heated home with a reduced cost. The methods listed are applicable to all types of fuels. [*"82 Ways to Conserve Fuel for Defense without Sacrifice of Home Comfort." Prepared in the interest of National Defense by Delco Appliance Division, General Motors Sales Corporation, Rochester, N. Y. Paper cover; 3¾ x 8½ in.; 22 pages. Available on request from Delco Appliance Division.*]

Oil Conversion. An instruction sheet containing information on how to change heating equipment from oil to anthracite. This sheet is being distributed to 10,000 retail anthracite dealers in order to give them information on how to use anthracite in heating units now equipped to burn oil. [*"How to Change Heating Equipment from Oil to Anthracite." Published by Anthracite Industries, Inc., 3207 Chrysler Building, New York, N. Y. Single sheet. Available on request from Anthracite Industries.*]

HEATING CHRYSLER CORPORATION'S



Here, leaving the Chrysler Tank Arsenal for the first time, is number one of the great fleet of monster M-3 medium 28-ton tanks which the Corporation has been commissioned to make for the U. S. Army.

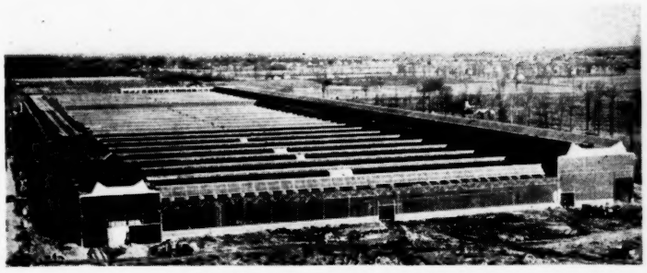
WILLIAM S. KNUDSEN, so the story goes, on June 9, 1940, asked K. T. Keller, president of Chrysler Corporation, if Chrysler Corporation would build tanks. Without hesitation Mr. Keller replied "Yes, where can I see one?" Five days later he and a group of his associates had returned from Rock Island Arsenal with 186 pounds of tank specifications and blueprints which were immediately taken in hand by 197 technicians who worked four and a half weeks making up estimates and plans. On August 15 Chrysler received a contract to build and equip a $20,000,000 plant on a 113-acre site to be used in the manufacture of tanks to be sold to the Government at a fixed price.

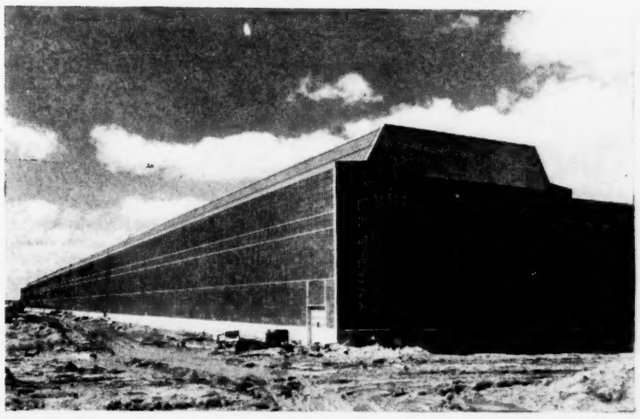
AIR CONDITIONING FOR DEFENSE

Less than a month later ground had been broken, and by January 28 steel erection was completed on the 500 x 1380 ft. Tank Arsenal. The project also includes a four-story 50 x 260 Administration Building, a one-story 50 x 160 ft. Personnel Building, and a Boiler House.

All buildings were practically complete and two pilot tanks had been turned out by April 24 when the plant was formerly dedicated in the presence of high officials of the Army, Office of Production Management,

TANK ARSENAL





Two views of the Chrysler Tank Arsenal as it appeared March 15. The building is five city blocks long and two blocks wide.

Chrysler Corporation, and other governmental and industrial organizations. The assembly lines will be in operation and the tanks being turned out in mass production by late summer of 1941.

The tank being manufactured at the Chrysler Arsenal is designated as a medium size (M 3) but actually is a huge affair weighing 28 tons and measuring approximately 20 ft long, 9 ft wide and 9 ft high. It carries a crew of five, has a top speed of 25 mph and is equipped with a 37 mm., a 75 mm., and four machine guns. It is driven by a 450 hp radial engine. Engines and armor are furnished to the plant, but all the rest of the parts and equipment are made or assembled at the Chrysler Arsenal plant, which will eventually employ from four to five thousand men per shift.

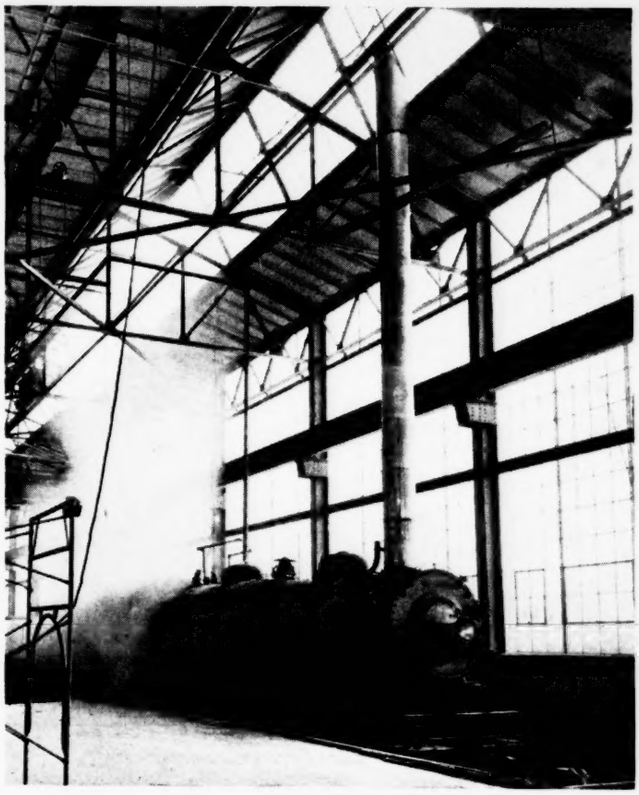
The buildings comprising the project are located on a 113-acre tract in Macomb Township near Detroit on which has also been built a 5500 ft long test track in the shape of an 8.

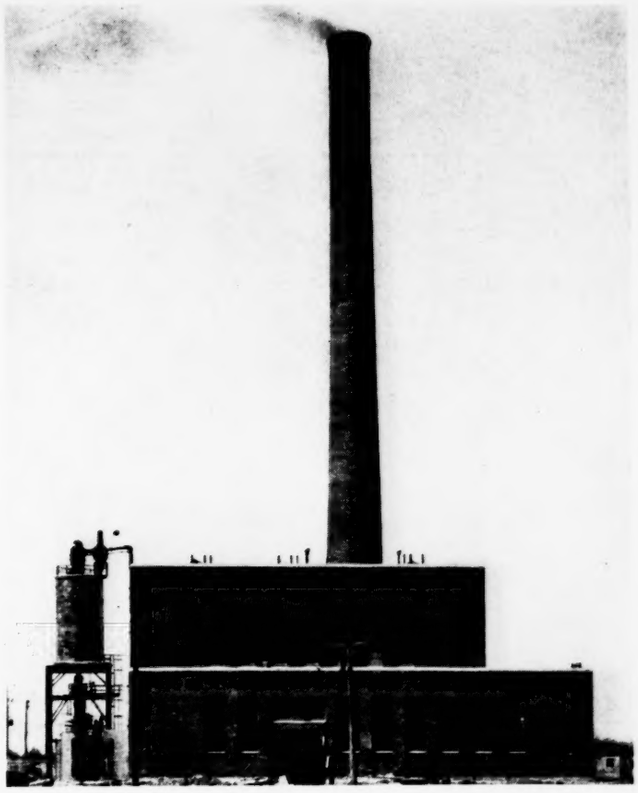
Boiler House

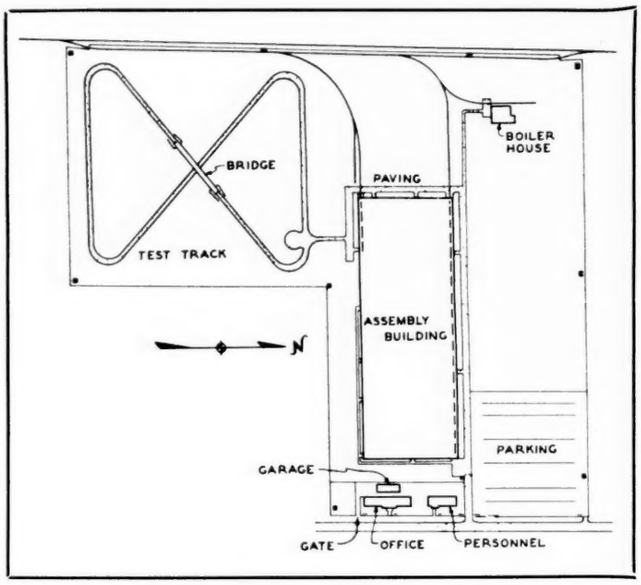
The boiler house is of steel and brick with a 150 ft stack. Coal is brought to the boiler house by rail and is conveyed automatically from cars to the rotary overfeed stokers under the three 750 hp boilers, each with a capacity of 60,000 lb per hr. Ashes are discharged to trucks or rail cars.

Steam is generated at 175 lb pressure and piped underground at this pressure to the arsenal for process uses, and to one of the two air compressors, each of which has a capacity of 1920 cu ft of free air per minute. The one air compressor is turbine driven and the exhaust from this compressor is used to help heat the arsenal in mild weather. In colder weather, when the

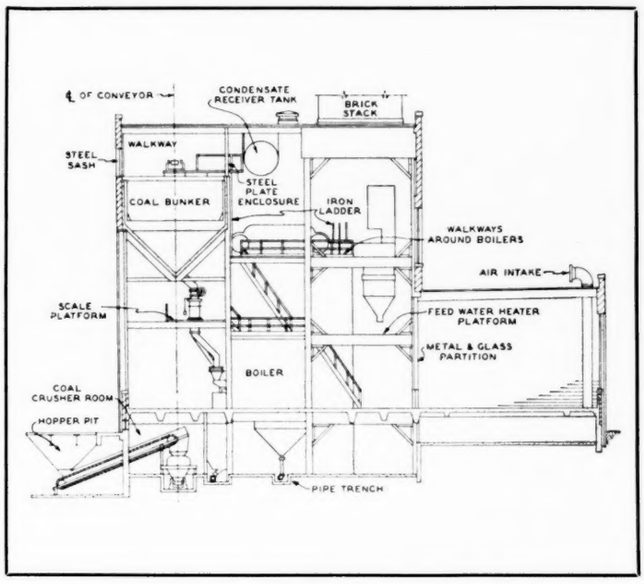
(Left) Prior to completion of the power plant a locomotive was used to provide temporary heat for the Arsenal. (Right) The power plant for the Chrysler Tank Arsenal, where steam is generated at 175 lb pressure.







Plot plan of the Chrysler Tank Arsenal.



Section through the power house.

exhaust is insufficient to heat the arsenal, high pressure steam is reduced to 30 lb and automatically fed into the heating lines to make up the balance of the steam required.

Arsenal

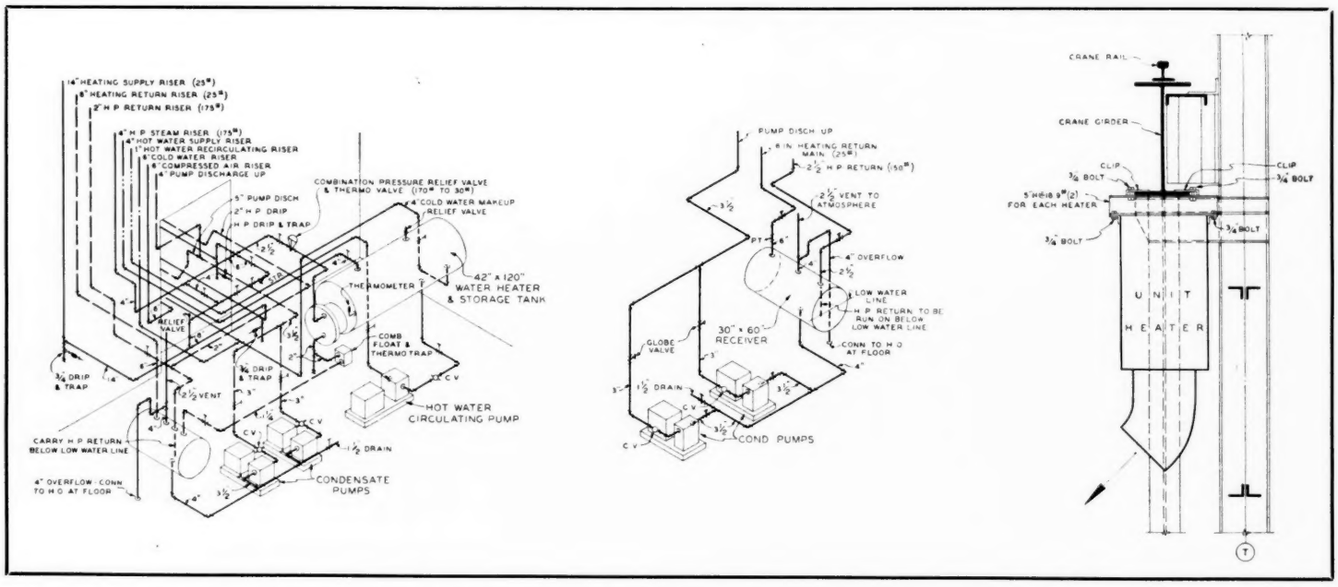
In the design of this plant speed was a matter of considerably more concern than the obtaining of an elaborate plant. The building itself is of one-story monitor type steel construction with continuous steel sash and brick curtain walls. About 95% of the wall surface is of glass with over 80,000 individual panes. Running the entire length of the plant on the north side (the plant lies east and west) is a bay 60 ft wide containing a depressed railway track and an unloading dock. At right angles to this are production aisles 60 ft wide across the building, through which fabricating parts will move to the 80 ft assembly aisle that runs the length of the south side.

Project Described Designed by **ALBERT KAHN** Associated Architects & Engineers, Inc.

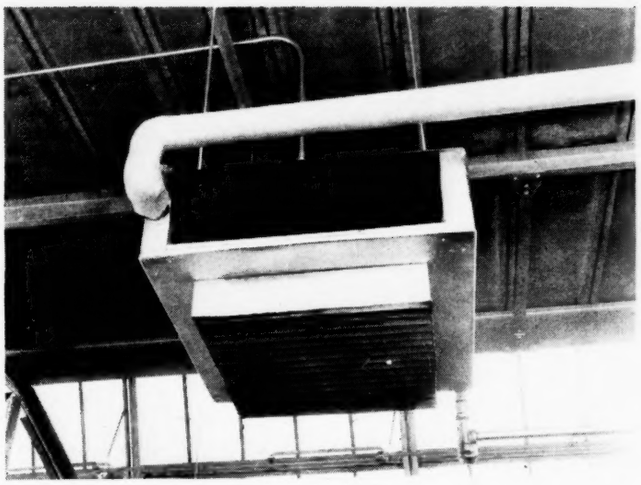
The roof is of precast cement tile covered with built up tar and gravel roofing, while the floor is 8 in. concrete slab covered with creosoted wood block except for the machine foundations.

Most of the main supply lines are kept outside the buildings. The 10 in. cast iron sprinkler piping from a 120,000 gal elevated tank circles the building, while 8 in. branches at 100 ft intervals run inside the floor to risers at the first interior row of columns. A concrete storm sewer takes the roof drainage. The main electric conduit from the powerhouse is also outside.

Steam enters the arsenal building at one end. The high pressure steam line runs through the building, approximately at the center line, with frequent expansion bends, and with the high pres-


COMBINATION PRESSURE RELIEF VALVE & THERMO VALVE (170° TO 30°)
42" x 120" WATER HEATER & STORAGE TANK
THERMOMETER
COMB FLOAT & THERMO TRAP
HOT WATER CIRCULATING PUMP
CONDENSATE PUMPS
CARRY H P RETURN BELOW LOW WATER LINE
PUMP DISCH UP
MAIN HEATING RETURN MAIN (25#)
2½ H P RETURN (150#)
2½ VENT TO ATMOSPHERE
4" OVERFLOW
LOW WATER LINE
H P RETURN TO BE RUN ON BELOW LOW WATER LINE
30" x 60" RECEIVER
GLOBE VALVE
CONN TO H O AT FLOOR
COND PUMPS
CRANE RAIL
CRANE GIRDER
CLIP
¾ BOLT
UNIT HEATER

(Left) Diagram of piping connections in the pump pit (not to scale). (Center) Pump and receiver connections (not to scale). (Right) Details of the unit heater arrangement under the crane rail.

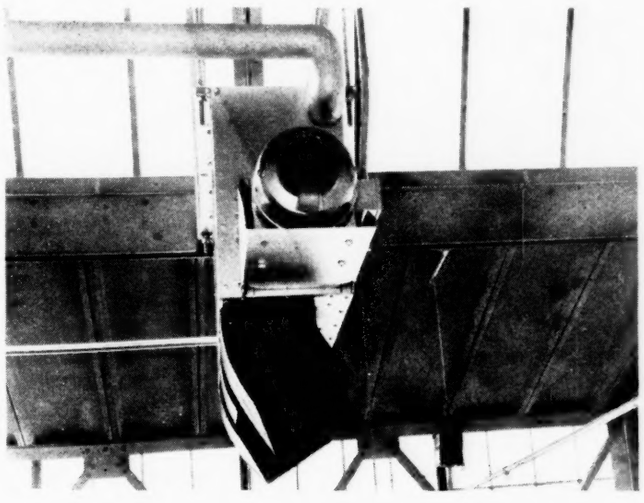


One of the projection type heaters in the Tank Arsenal.

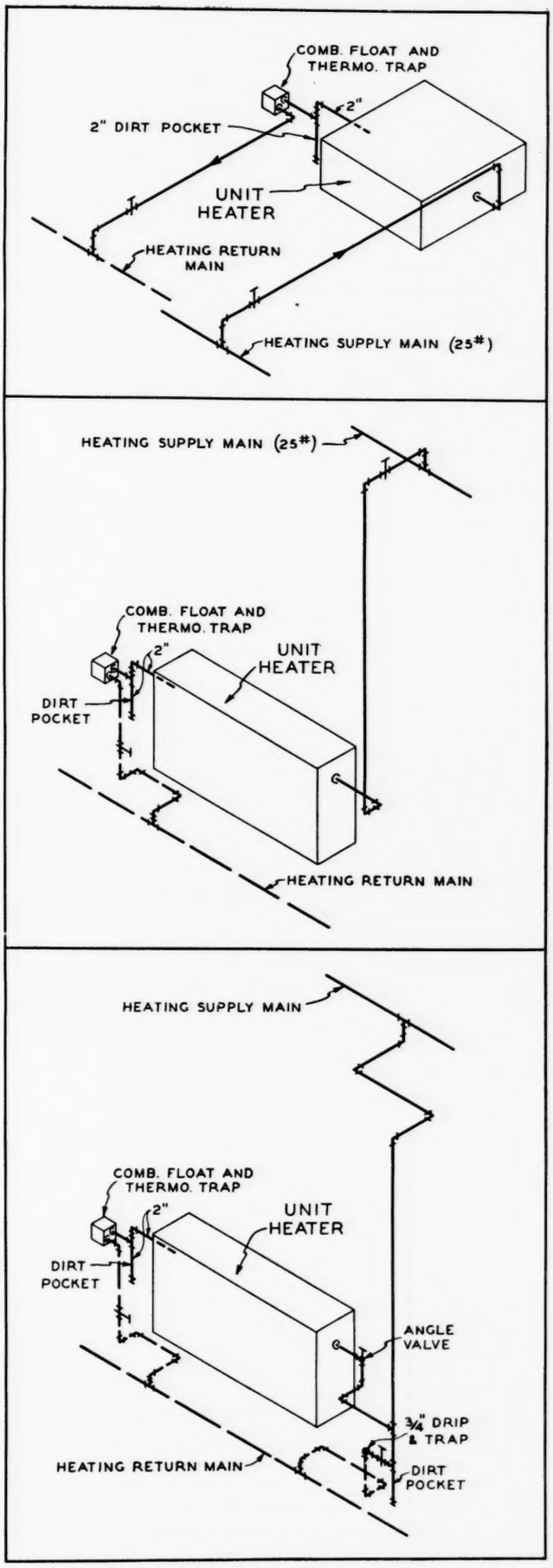
sure return parallel to it. Low pressure steam is distributed through four lines running through the building and to which are connected mains running crosswise through the building at 60 ft intervals. Expansion in the steam heating system is taken care of by expansion bends. Piping 3 in. and over is welded.

Projection type unit heaters are connected to the cross piping at 90 ft spaces in which each line of unit heaters is staggered with the line in adjacent mains, so that each heater covers a floor area of approximately 5000 sq ft. The heating system itself is a two-pipe gravity steam within the arsenal and with the condensate collected at each end of the building and pumped back to the main receiver in the boiler house.

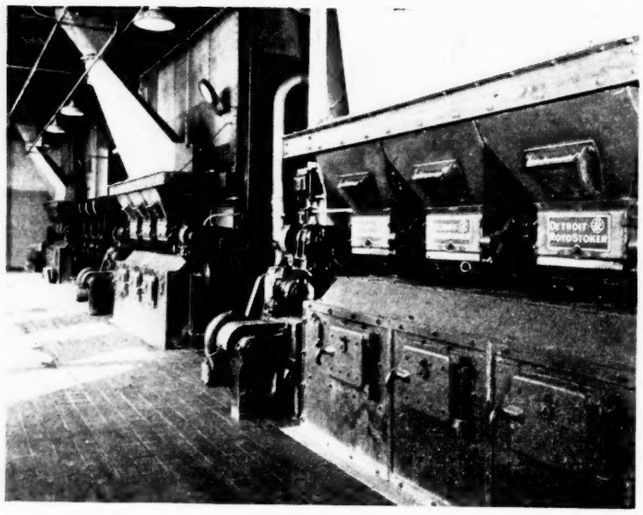
Unit heaters in the center portion of the building are controlled with thermostats located near the unit heaters and equipped with on or off manual control and with a third position for thermostatic control. The units are normally operated from the automatic position and the *on* and *off* hand positions are used primarily in the summer when the units are used for air movement. In the craneways the unit heaters are not of the projection type but of the conventional horizontal flow type arranged to blow from both sides along the craneways. Certain of these, as well as many of the projection type units located near doors, are equipped with door



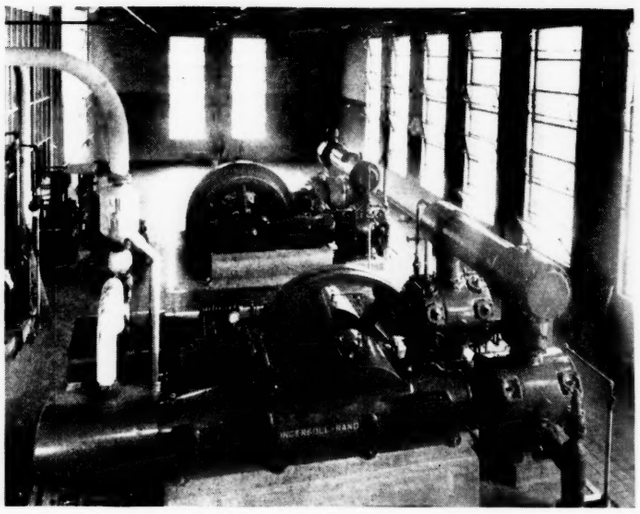
Blower type unit heater in Tank Arsenal.



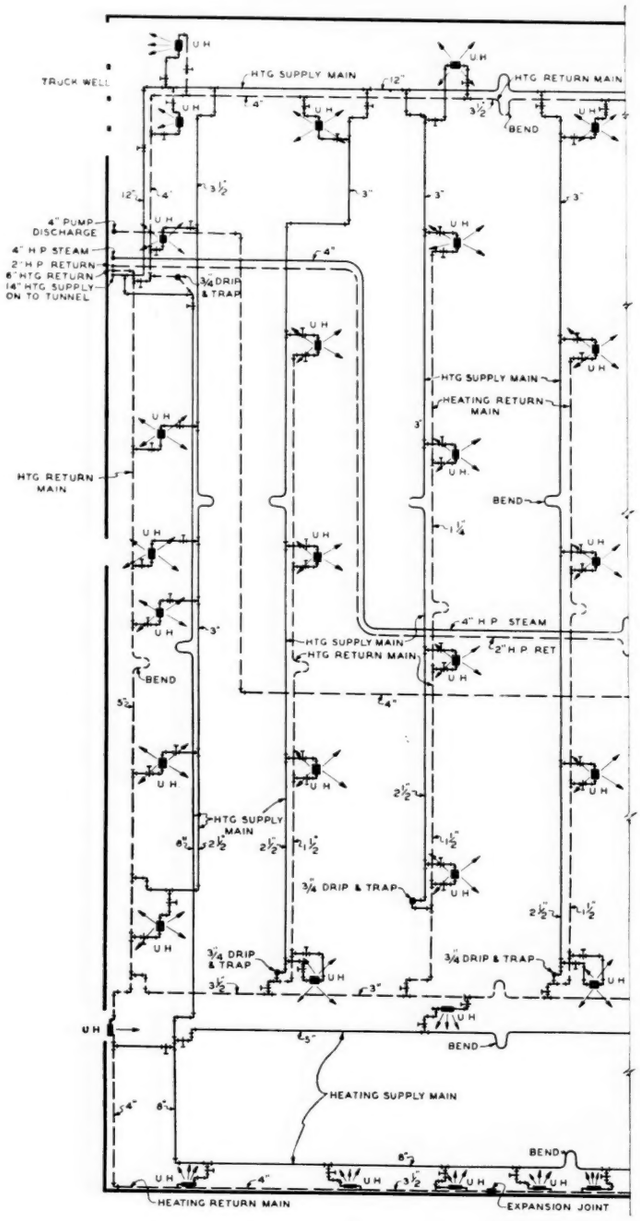
Top, typical connection for projection type heaters. Center, connections when taken off top of main. Bottom, supply connections as taken off the bottom of the main under the crane rail.



View in the power plant building, showing front of boilers and stokers.



Air compressors in the power plant. The exhaust from the reciprocating engine is used for heating.



A section of one end of the Tank Arsenal, showing the heating lines. The remainder of the factory is simply an extension of the arrangement shown in this drawing.

switches arranged to start the unit heater fan regardless of the thermostat when the door is open and to permit the motor to run when the door is shut until stopped by the thermostat. Piping in the craneway runs along both sides and is connected to the lateral piping at the ends of the building.

The accompanying table shows the unit heater schedule.

UNIT HEATER SCHEDULE
(ALL 3 PHASE, 60 CYCLE, 440 VOLTS ON 20 LB STEAM)

Number Used	Size, Btu per Hr	Entering Air Temperature, F	Maximum Final Temperature, F	Type	Type Outlets
30	560,000	70	130	Vertical	Diffusers
3	500,000	70	130	Inv. Blower	Directional Outlets
40	685,000	70	130	Inv. Blower	Directional Outlets
51	385,000	70	130	Vertical	Diffusers
21	450,000	70	130	Vertical	Diffusers
6	200,000	70	130	Inv. Blower	Directional Outlets

In the large craneway five vertical shaft propeller fans with a capacity of 8000 cfm and multiple discharge outlets are located so as to force the warm air, which would rise in the high craneways, down to the floor, and thus prevent overheating near the roof.

Float and thermostatic traps are provided at the drips in the heating line and at the return from each unit heater.

Two condensate pumps and receiver units serve the arsenal building. Each unit consists of two pumps and controls, a receiver tank and miscellaneous accessories, controlled by float switches and automatic controllers with line switches. Controllers are wired so that the pumps will operate alternately and so that the second pump will start if the first is unable to carry the load. One unit has a capacity of 75 gal per minute at 125 ft head, the other a capacity of 80 gal per minute at 100 ft head.

Other Buildings

Other buildings in the project are also heated by steam with returns run by gravity to a condensate pump and receiver unit. The garage has overhead unit heaters with one convector radiator in the boiler room on 25 lb steam. The office building is heated by direct radiators, steam at 2 lb pressure, but with a forced air heater in the vestibule to overcome high heat losses there. The personnel building has 2 lb steam direct radiators. All condensate returns are run to the condensate pump and receiver unit in the office building.

The piping to these buildings is connected at the end of the 170 lb steam main at the east end of the main arsenal building where two pressure regulating valves, one for winter and one for summer, are provided. These valves are connected in parallel and reduce the steam to 25 lb. From these pressure regulating valves the steam main runs underground through conduit to the garage where it rises to the ceiling with a connection taken off to serve the unit heaters in the garage, then crosses the garage, drops into underground conduit and crosses to the office building where it rises and divides into two mains. One of these has another pressure regulating valve to reduce the pressure to 2 lb where it drops and runs through underground conduit to the personnel building; the other has a pressure regulating valve in the janitor's room for reducing the pressure to 2 lb for the heating system in the office building.

Steam and return mains in the garage are overhead while in the office building the steam main is above the third floor ceiling and feeds down to the return main under the first floor radiators, excepting that in some locations the return mains crossing the office building are run under the floor in tile. Steam and return mains in the personnel building are located in a pipe trench under the floor along the outside walls.

Unit heaters in the garage blowing toward the doors are of high velocity blower type while for heating the lobby of the office building a self-contained unit heater, mounted horizontally, is used. All other unit heaters are of the projection type.

Industrial Building Now the Prime Market

(Concluded from page 22)

ing, of a type of construction that can well be deferred when conditions warrant.

During the initial half of 1941 apartment house building involved expenditures that were *less* by some 11% than for the like 1940 period. In 1941, this building type represented only about 14% of all residential building and less than 7% of all building, exclusive of heavy engineering. In the corresponding six months of 1940 the ratio of apartment building to all residential building, thanks in part to greater emphasis then than now on public multi-family housing, was about 21%, while as to total building the ratio for apartments only was about 13%.

Now we are ready to draw off some of the more significant conclusions as to 1941 as a whole. Here they are. Manufacturing building promises to end the year with a volume between 85 and 90% greater than that shown in 1940. Because of special localized conditions hotel construction will likely show about the same range of percentage gain. Commercial buildings of every description will likely record an increase of between 15 and 20%, social and recreational buildings of between 10 and 15%. Against these gains, losses of from 10 to 15% are all but certain for educational building, hospitals and institutions and other public purpose buildings. Religious buildings will probably end the year with a total not far, one way or the other, from the volume level of 1940 while miscellaneous non-residential buildings, not otherwise classified, will likely record an increase of between 40 and 50%.

1-family houses constructed by individuals for their own occupancy will probably show a loss, ranging between 5 and 10%; apartment house building is virtually certain to show a shrinkage, perhaps as much as 20%. Against these likely losses in residential building types there may be set indicated probable gains in 1-family houses erected for sale by operative builders of between 25 and 35% and in 2-family houses of from 50 to 60%.

Summarizing, total building in 1941, exclusive of heavy engineering, seems destined now to show an increase of between 15 and 20% over the corresponding total for last year; for residential building as a whole, the indicated increase seems to lie within a range of between 5 and 10%; but for non-residential building a gain of at least 30% is now all but assured. Below are my estimates in dollar amounts.

BUILDING IN 37 EASTERN STATES
(F. W. Dodge Corporation Basis of Coverage. Millions of Dollars)

	1941 Estimates	1940 Reported
Residential Building	$1,675-$1,750	$1,597
Non-Residential Building	1,685- 1,750	1,295
Total Building	$3,360-$3,500	$2,892

In any event, that building in 1941 will have scaled all annual records since those of 1929 is now about certain. What is uncertain and now extremely dubious, because of mounting building costs and the constrictions forced by existing and coming priorities, is that building can soon decisively pierce the levels of the latter nineteen-twenty's (see Table 1). For, with increasing emphasis on necessitous defense building needs, there is in the making a greater diversion from non-necessitous types. And when building in such more or less non-necessitous classes begins to shrink in volume this will impose too great a burden upon defense-induced construction to carry the load of providing overall building totals in excess of those witnessed 12 to 15 years ago. Yet, whatever may happen, even in this respect, is distinctly in the field of longer range probabilities for which there will be time enough to make further appraisal after the full record for 1941 will have been written.

NEWS OF THE MONTH

Priorities for Defense Housing

WASHINGTON—Within a short period the hesitancy and uncertainty which have filled some builders' minds because of the imminence of priority ruling affecting residential construction are due to be swept away.

The procedure for issuance of priorities for defense housing, now being drawn up jointly by the Division of Defense Housing Coordination and the Priorities Division of the Office of Production Management, probably will be made public early in August, according to the Office of Emergency Management.

The program and procedure being worked out under the direction of E. R. Stettinius Jr., Director of Priorities, and Charles F. Palmer, Defense Housing Coordinator, probably will give a broad definition to defense housing, to cover most construction in this area where the intended sales price is $6,000 or less, or the prospective rent $50 a month or less, and where "reasonable" preference is given to workers in defense industries, it was learned.

"With the concurrence of the Army and Navy Munitions Board, the Priorities Division will be ready to give publicly financed defense housing projects and areas named by the Defense Housing Coordinator preference ratings appropriate to the type of national defense activity in a given neighborhood," one Federal official here explained.

"Also under preparation is a defense housing 'critical' list. This will include items which, in the opinion of the Priorities Division, may be obtained in quantities and at times needed only by preference ratings.

"Materials vital to defense, such as steel, aluminum, copper, nickel, bronze and zinc, will be excluded, except when the Defense Housing Coordinator demonstrates that these items are absolutely essential and adequate substitutes cannot be used. Application for materials not on this list may be made to the Priorities Division on its form PD-1."

Procedures being prepared will apply to materials for rehabilitation of existing structures as well as for new construction, where a dwelling unit otherwise not available would be rendered habitable.

A.C. for Gear Hobbing Rooms

PITTSBURGH—Air conditioning will play a part in a new $22,000,000 plant to be built by Westinghouse to manufacture steam turbines and gears for merchant ships for the Maritime Commission. Manufacturing equipment will include 16 big gear hobbers, to be enclosed in air-conditioned rooms.

Electrically heated suit for air corps

Electric Flying Suits for Air Corps

NEW YORK—The first large-scale contract for a newly developed electrically heated flying suit to keep aviators warm at high altitudes has been awarded to General Electric Company, Bridgeport, by the U. S. Army Air Corps. The order is the largest single order ever received by the appliance and merchandise department of the company.

Designed to keep an aviator comfortable through a 130F range of temperatures from 70F to —60F, the new flying suit is wired throughout and the amount of heat supplied electrically is controlled to adjust for changes in temperatures.

The advice of arctic explorers, physicians, and laboratory scientists, as well as that of flying men, contributed to the final design of the flying suit. Exhaustive laboratory tests were followed by flying tests by test pilots at Patterson Field throughout the winter. One bomber crew flew to Alaska in electrically heated underwear.

During the investigations the electrically heated uniform of a German aviator shot down over England was analyzed by the research laboratory and was found to be so inadequate in the amount of heat it supplied as to be almost worthless.

Electrically, the complete assembly consisted of two circuits for the suit, one circuit for gloves and one for boot inserts. The four circuits were connected to a switchbox at the waist which permitted independent use of heat in shoes, gloves or suit. From the switchbox a short pigtail connection provided means for connecting the assembly to the control box which in turn was mounted on the ship and connected with the source of power, the ship's batteries.

Market for A.C. in Skyscrapers

SYRACUSE—This country's skyscrapers—the office buildings, apartment houses, hotels and hospitals 10 stories or more in height—represent the greatest immediate commercial market for air conditioning, in the opinion of Dr. Willis H. Carrier, chairman of the board of Carrier Corporation.

"The latest figures available show that only 5.46% of the nation's office buildings are air conditioned," he pointed out. "The apartment house picture is even more startling, with only 0.3% air conditioned. According to a recent survey in the hotel field, 13.9% have been completely or partially air conditioned."

Some idea of the tremendous market represented by large buildings is indicated by the fact that there are 4,065 tall structures 10 or more stories high in New York City alone. There are 497 office buildings in New York 10 stories and over; 138 hotels; 2,456 elevator apartments, 159 apartment hotels; 212 cooperative apartment houses; 16 large motion picture houses with buildings attached; and 199 public buildings, hospitals, museums, etc.

The most recent survey showed that air conditioning had been installed in 3,010 industrial plants, or 1.78% of the nation's 169,111 factories.

In the industrial market, tobacco factories ranked first as the most completely air conditioned industry. Yet only 25.3% of the nation's tobacco plants are air conditioned.

Candy factories ranked second,—a survey of the nation's candy plants conducted last Summer, revealed that 14.4% of the total had air conditioning in one form or another. Much of it had been installed more than 10 years ago, however. The candy industry, because of its chocolate-dipping problem, was one of the first to recognize the importance of conditioning.

In third place in the industrial field are fur storage plants, with 6.5%. In only a few other industries has even 1% of the saturation point been reached up to now.

In commercial markets, 40,247 installations had been made. This represented a total of only 2.8% of the saturation point in that field. In this market, theatres outrank all other markets by a wide margin. Department stores rank second, although only one out of every five department stores have been air conditioned. Drug stores report 1.58% air conditioned; restaurants, 2.3%; and banks 2.89%.

It is estimated there are 23,000,000 electrically wired homes in the United States, but only about 80,000, or .003½% of them, have any form of air conditioning whatsoever.

Ickes Threatens Gas and Oil Rationing on Eastern Seaboard; OBI Drives for Funds to Combat Unfavorable Publicity

NEW YORK—New developments during July in the threatened fuel oil shortage along the Eastern Seaboard were not very startling. Late in the month (July 28) Petroleum Coordinator Ickes stated that despite his plea for a reduction in oil consumption in eastern states, there had been a million and a half gallons increase in gasoline consumption.

He stated that "we can only conclude that our many exhortations to conserve oil and gasoline have fallen on indifferent ears and that it will be necessary to put into effect some system of involuntary rationing.

"The figures that we will get from the oil companies during the next week or two, when compared with those of today, will show whether there is any reason longer to hope that automobile owners and householders who burn oil will do willingly what we must all do if the common good is to be served."

On the heels of this statement, Mr. Ickes announced an order to all gas stations to close between 7 p.m. and 7 a.m., effective August 3. Compliance with the order, however, is voluntary.

The Japanese crisis resulted in the Government announcing that it would restrict the flow of oil from this country to Japan. However, as far as the fuel oil situation is concerned, this will probably have no bearing since the problem along the Eastern Seaboard is one of transportation and the stoppage of shipment to Japan will not release tankers for eastern use because this oil has been carried by Japanese tankers.

Indications that there would be a reduction in production of oil heating units of the order of 20 to 25% were seen in a talk by W. A. Mathison, vice-president of Williams Oil-O-Matic Heating Corporation, before Williams' dealers in New York, July 23.

On the same day Coordinator Ickes announced that the transfer of oil tankers, or the reallocation or diversion of tankers is a matter of vital military information and, consequently, no information would be made public in the future regarding such transfers or allocations.

An aerial survey was started on July 29 for the 1560 mile oil pipe line from Texas to New York in order to relieve the oil shortage along the Eastern Seaboard. OPM, it is reported, has given assurance that the job will be given priority in obtaining materials for the 22-inch line from the Texas field to Salem, Illinois, and the 24-inch line from Salem to New York. Thirteen miles of the line will be completed daily, it is said.

Late in June, an order signed by G. R. Cottrelle, Oil Controller for the Department of Munitions and Supply, Dominion of Canada, completely prohibited the sale, distribution, and installation of any oil burning equipment throughout Canada for the duration of the emergency. The order also barred the sale of oil for any installation not operating as of the date of the order, June 24.

At an oil burner industry meeting held at Eastern Point, Conn., July 21, and sponsored by the Oil Burner Institute, an emergency committee adopted a basis of 3/10 of 1% of 1940 net sales to the oil heating industry as the recommended subscription rate by manufacturers interested in the oil burner market.

The purpose of the campaign is to raise funds to "rebuild the morale of every member of the industry and to re-assure the public" following the "adverse publicity given the oil transportation bottleneck."

Attention was called to the fact that oil burner competitors have been quick to capitalize on the present situation; that stoker sales have climbed; that the anthracite industry is sponsoring a broad dealer program to switch oil consumers to coal, and that gas appliance manufacturers are equally busy.

Manufacturers asked to subscribe in the emergency campaign include those making conversion burners, boiler-burner and furnace burner units, commercial burners, burner controls and accessories, heating equipment and accessories, distillate equipment, oil handling and delivery equipment, and insulation storm sash and weather stripping.

The money so raised will be spent for (1) newspaper advertising in major oil heating markets in the affected area, (2) trade paper advertising to arouse dealers to the full realization of the emergency facing the business, and (3) for dealer selling helps.

The quota of the campaign is $150,000 of which over $41,000 has been subscribed, and over $19,000 paid in.

The newspaper campaign was opened July 16 in advertisements in the *New York Herald Tribune* and the *Washington Star*. This advertisement, addressed to home owners, outlined four ways to save money whatever type of fuel the owner uses and included a pledge card to be sent to the emergency committee saying that the signer planned to call his local dealer and arrange to have his heating plant tested and kept at maximum efficiency during the coming winter.

Dr. John W. Frey, director of marketing in the Office of the Petroleum Coordinator, told suppliers of heavy fuel oil on July 30 that "drastic cuts" in the consumption of heavy fuel oil in the Atlantic Seaboard States would have to be made in the immediate future to meet the impending shortage. The oil supplying industry was asked to supply detailed information as to customers whose plants might be immediately or readily convertible to use of coal instead of oil. Dr. Frey told the conference of suppliers that "there are going to be cuts and they are going to be substantial."

Participating in the two and one-half hour long conference, besides officials of the Petroleum Coordinator's office and industry representatives, were representatives of OPM and of the OPACS. The purpose of the meeting was to lay the ground work for priorities for delivery of stokers and other necessary machinery for the changeover, and on fuel oil.

Seek Funds for Oil Burner Drive

BOSTON—A call has been sent out by the Massachusetts Oil Heating Association to everybody interested in the oil heating industry to subscribe to a publicity fund, to be used to combat the adverse publicity regarding fuel oil supplies in New England that has been widely published in newspapers. The bulletin states that oil burner sales are rapidly reaching an all-time low. "Are you going to take this lying down," queries the bulletin. "Are you a man or a mouse. Have you the stamina to make a fight for your right to continue in business, to sell and serve the purchaser who wants the advantage of oil heat, but has been scared to death by the news releases and the stories spread by the competitors of oil heat? This is more than a fight—it is a CRUSADE."

The proposition set forth is that each member of the industry, whether oil burner dealer, oil dealer service man or even salesman subscribe to a fund to take advertising space in the newspapers and have quantities of reprints of these ads available to the subscribers for distribution.

USHA Plans Rural Homes

WASHINGTON — Seventy-three additional low-rent housing projects, mostly in rural areas, have just been approved by President Roosevelt, it was announced July 26 by Nathan Straus, Administrator of USHA.

Of the total, fifty-three are in Mississippi and Louisiana counties and parishes. Louisiana regional housing authorities will build 1,070 homes and Mississippi authorities 950.

Credit Men Elect Bigelow

NEW ORLEANS—Credit men from the plumbing and heating industry assembled at the 46th annual Credit Congress of the National Association of Credit Men here, held special sessions devoted to the problems of their industry. R. L. Griffiths, International Heater Co., Utica, N. Y., was chairman of the sessions.

Walter Cooke, manufacturers agent, spoke on sales and credit cooperation, discussing the nature and cost of credit difficulties. H. S. Armstrong, credit manager of Rudolph Ramelli, Inc., of this city, spoke on "Economy of Automatic Coal Heat" and K. S. Thomson, secretary, reported on the Builders Clearance Service offered to building material firms in Oakland, Calif.

"Credit Enforcement Remedies and Recourses" was the subject of a paper by Leon S. Cahn, local attorney, in which he urged that the industry take advantage of the extraordinary protection of the material man's lien. He said, "I realize that the sales department, looking for future business, is not anxious to see liens filed, but the credit department cannot discharge its full responsibility to the company unless it liens in every case where there is the slightest doubt. If a uniform policy of recording a lien on every job were adopted by all of the plumbing and heating houses in each locality, the contractors and owners would soon become accustomed to taking these liens as a matter of course, and the industry as a whole would be thoroughly protected. Your salesmen would have no reason to protest against liens if the credit men of their competitors pursued the same policy."

The group adopted a resolution on cash discount adherence as follows: "Resolved that we of the plumbing and heating industry have experienced more cases of extended cash discounts in the immediate past, and we, therefore, strongly urge that all credit men in the field hold strictly to the cash discount period, disallowing any deductions beyond the established trade terms, and that the N.A.C.M. through its magazine, 'Credit and Financial Management,' strongly publicize the seriousness of failure of purpose of the Cash Discount, and emphasize that it is a premium for prompt payment and can only be earned by adhering to the terms."

The following officers and committee were unanimously elected for the coming year: chairman, Frank V. Bigelow, Malleable Iron Fittings Co., Branford, Conn.; vice-chairman, Everett Dickey, Mueller Co., Decatur, Ill.; committee, Emily Davidson, Chicago Pump Co., Chicago, Ill., J. F. Metzger, Crane Co., Cincinnati, Ohio and Harold J. Rooney, Grinell Co., Toronto.

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This figure is practically double the $12,753,326.68 in industrial building activity recorded for the fiscal year ending June 30, 1940, and more than five times the $4,682,443 for the prewar fiscal year ending June 30, 1939.

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Los Angeles to Revise Code

LOS ANGELES—Financed by a $25,000 appropriation from the City Council, a group of four experts representing various divisions of the Los Angeles Building and Safety Department is rewriting and revamping the municipal building code. Revision of the heating and ventilating sections of the code are being given special attention. To this end two men have been drafted for code work from the heating and ventilating divisions of the Building and Safety Department. The code committee has been supplied with a copy of a proposed ventilating code prepared by A. B. Wicks, head of the Division. This proposed code will be incorporated as a whole into the building code, or will be fitted in partly to cover phases of ventilator inspection now inadequately covered by municipal provisions.

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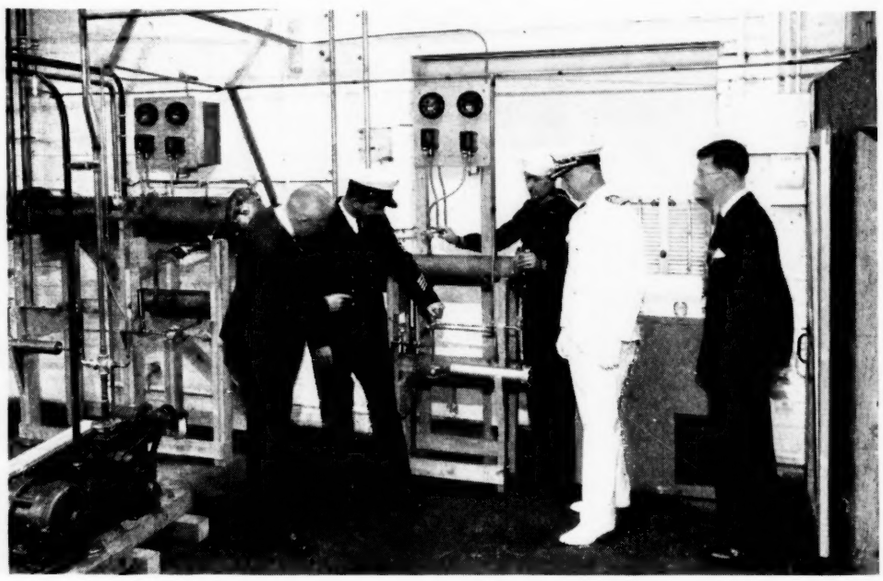
Superintendents of building maintenance are also needed by the government.



YORK OPENS NAVY TRAINING SCHOOL

A group of key service men from the Atlantic and Pacific fleets of the United States Navy on July 7 began a six-weeks course of instruction in the operation and maintenance of air conditioning and refrigerating equipment, conducted by the York Ice Machinery Corp., at their plant in York, Pa. Shown here in the specially built York-Navy school laboratory are, left to right: S. E. Lauer, president of the York Ice Machinery Corp.; Chief Machinist's Mate A. D. Collins of the Submarine Tender U.S.S. Holland; H. E. Hilsenberg, Machinist's Mate of Submarine Squadron No. 4; Commander T. J. Bay of the Bureau of Ships, and F. B. Kinley of York Ice Machinery Corp., civilian director of the course.

Coal Industry Advises on Fuel Change

NEW YORK — Both consumers and anthracite retail dealers are being advised by the anthracite industry that it is fully prepared to help them meet any possible contingencies arising from a possible oil shortage due to the national defense emergency. The agencies of the industry are already set up to give major assistance through their field staff of heating men in principal cities, equipment display rooms and combustion engineering laboratories.

Instruction sheets containing data on how to change heating equipment from oil to anthracite have been sent to ten thousand retail anthracite dealers. Supplementing this preparation within the industry in anticipation of the future heating requirements of the public under emergency conditions, it is planned to hold dealer meetings throughout the anthracite burning area where more specific instruction and education can be given retail dealers in assisting them in making the necessary conversions to permit the use of anthracite in those heaters now equipped to burn oil. The laboratory staffs are concentrating their time in studying every phase of standard and special grates and grate replacements.

Knock-Down Houses for Defense

WASHINGTON—Determined that the end of the defense effort shall not be marked by hundreds of stranded communities with tumble-down buildings, defense housing agencies have turned to a type of dwelling that can be put aboard a railway car or truck after the emergency, to follow the workers to localities of stabilized employment.

The Public Buildings Administration reports that 11,000 such homes have been built or are under construction. Facing the prospect of providing houses for more thousands of defense workers, the agency announced a plan to prove the moving qualities of the prefabricated, demountable structures.

At Indian Head, Md., eleven manufacturers supplying demountable dwellings were asked to put on a demonstration, to show the speed and cost at which they can take down their houses and establish them elsewhere. Each manufacturer will take down one of his structures, haul the pieces to a community nearby, reconstruct it—then take it down a second time and haul it back to Indian Head, there putting it up again in condition for occupancy.

The demountable houses, bolted together, come in one- and two-family sizes. A one-family unit consists of living room, two bedrooms, kitchen, dinette and bath. P. B. A. indicated it expected the manufacturers to take apart a one-family unit, haul it to another locality, and put it up again, all in one day.

Construction Unit for U.S. Dept.

WASHINGTON—Establishment of a construction unit in the Bureau of Foreign and Domestic Commerce, Department of Commerce, was announced here July 21 by Director Carroll L. Wilson, who said the move was prompted "by a very evident need for a more complete and detailed analysis of current conditions in the construction industry."

Working with other government agencies in the correlation of statistical activities, the new unit will endeavor to develop, cooperatively, with government and industry, a statistical program designed to provide accurate and comprehensible data on all phases of construction in the United States.

S. Morris Livingston of Weston, Mass., has been appointed to direct the work of the new unit. Joseph H. Ehlers of Hartford, Conn., has been appointed technical assistant.

Boston A.C. Sales Mount

BOSTON—There has been considerable activity in the air conditioning field of the Boston metropolitan area lately, and many new installations are reported by the Air Conditioning Division of the Boston Edison Company. There are now a total of 1900 installations in the metropolitan area, representing over 19,000 horsepower applied to operation of the equipment.

One large installation for a new grocery store shortly to be opened in the heart of the shopping district by the S. S. Pierce Company, calls for over 50 hp. This is one of the oldest grocery firms in the country, doing a wholesale and direct importing business as well as retail. Seven restaurants and another store of the Liggett drug chain, which already has air conditioned several of its larger stores, are included in recent installations.

Cork Advisory Group Set Up

WASHINGTON—Selection of a nine-member Cork Defense Industry Advisory Committee was announced here July 14 by the Bureau of Clearance of Defense Industry Advisory Committees, Office of Production Management.

The committee was established by OPM to advise and consult with Dr. Harry S. Rogers of the priorities division, who has been designated government presiding officer of the committee.

Prizes for Design of Building

NEW YORK—A $3,750 prize competition for a design for the Brooklyn-Battery tunnel ventilation building, which will be built off Governors Island in the Upper Bay, was announced July 20 by the New York City Tunnel Authority, 200 Madison Avenue.

Pittsburgh Adopts Smoke Law

PITTSBURGH—An anti-smoke ordinance, designed to lift the pall from Pittsburgh in two years and expected to serve as a model for other Western Pennsylvania cities in eliminating the smoke nuisance from the entire area, has been given final approval by the City Council and signed into law here July 8 by Mayor Scully. Also enacted was an accompanying measure providing for enforcement through the establishment of a Bureau of Smoke Prevention.

Drafted by the Pittsburgh Smoke Commission after long months of study inspired by the success of anti-smoke efforts in St. Louis, the new ordinance will become partially effective Oct. 1, when industrial plants, business establishments, apartment buildings and hotels will be brought under its provisions.

Robert C. Farrington

CLEVELAND—Robert C. Farrington, 59, chief mechanical engineer of The Austin Company since 1919, died at Fort Worth, July 15, following a heart attack about two weeks ago. At the time of his death, Mr. Farrington was in Texas working on equipment details for the two huge windowless Army bomber plants now being erected at Fort Worth and Tulsa, Oklahoma.

R. C. Farrington

Mr. Farrington had been associated with Austin since 1918, when he joined the Austin organization as a mechanical engineer at the district office in Philadelphia.

Mr. Farrington was graduated from Syracuse University as an electrical engineer in 1903 and for the next two years was employed as engineer and estimator with W. N. Tobin in New York City. From 1906 to 1913 Mr. Farrington was engaged in professional engineering work, first in New York as a partner of Sorenson & Farrington, and subsequently in Syracuse under the name of Farrington & Berdsoll. In 1913 he became president and general manager of the York Engineering Company at York, Pa., and continued in that capacity until he joined the Austin organization.

Mr. Farrington was in charge of all mechanical engineering work on the huge $60,000,000 automobile city built by Austin for the Soviet in 1930, and returned home to supervise the working out of control facilities for the world's first windowless factory, which Austin designed and built for Simonds Saw & Steel Company at Fitchburg, Mass., in 1931. He is survived by his wife, a son and daughter.

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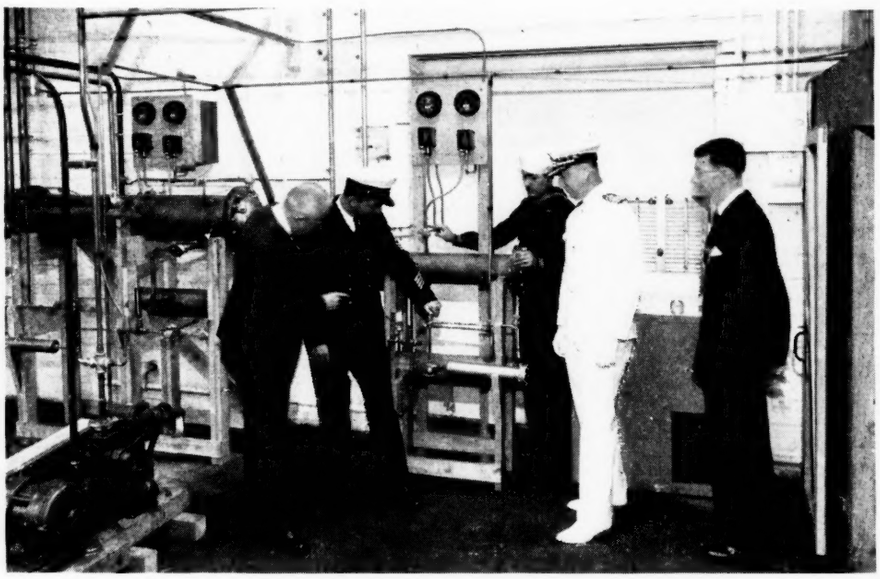

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A group of key service men from the Atlantic and Pacific fleets of the United States Navy on July 7 began a six-weeks course of instruction in the operation and maintenance of air conditioning and refrigerating equipment, conducted by the York Ice Machinery Corp., at their plant in York, Pa. Shown here in the specially built York-Navy school laboratory are, left to right: S. E. Lauer, president of the York Ice Machinery Corp.; Chief Machinist's Mate A. D. Collins of the Submarine Tender U.S.S. Holland; H. E. Hilsenberg, Machinist's Mate of Submarine Squadron No. 4; Commander T. J. Bay of the Bureau of Ships, and F. B. Kinley of York Ice Machinery Corp., civilian director of the course.

Coal Industry Advises on Fuel Change

NEW YORK — Both consumers and anthracite retail dealers are being advised by the anthracite industry that it is fully prepared to help them meet any possible contingencies arising from a possible oil shortage due to the national defense emergency. The agencies of the industry are already set up to give major assistance through their field staff of heating men in principal cities, equipment display rooms and combustion engineering laboratories.

Instruction sheets containing data on how to change heating equipment from oil to anthracite have been sent to ten thousand retail anthracite dealers. Supplementing this preparation within the industry in anticipation of the future heating requirements of the public under emergency conditions, it is planned to hold dealer meetings throughout the anthracite burning area where more specific instruction and education can be given retail dealers in assisting them in making the necessary conversions to permit the use of anthracite in those heaters now equipped to burn oil. The laboratory staffs are concentrating their time in studying every phase of standard and special grates and grate replacements.

Knock-Down Houses for Defense

WASHINGTON—Determined that the end of the defense effort shall not be marked by hundreds of stranded communities with tumble-down buildings, defense housing agencies have turned to a type of dwelling that can be put aboard a railway car or truck after the emergency, to follow the workers to localities of stabilized employment.

The Public Buildings Administration reports that 11,000 such homes have been built or are under construction. Facing the prospect of providing houses for more thousands of defense workers, the agency announced a plan to prove the moving qualities of the prefabricated, demountable structures.

At Indian Head, Md., eleven manufacturers supplying demountable dwellings were asked to put on a demonstration, to show the speed and cost at which they can take down their houses and establish them elsewhere. Each manufacturer will take down one of his structures, haul the pieces to a community nearby, reconstruct it—then take it down a second time and haul it back to Indian Head, there putting it up again in condition for occupancy.

The demountable houses, bolted together, come in one- and two-family sizes. A one-family unit consists of living room, two bedrooms, kitchen, dinette and bath. P. B. A. indicated it expected the manufacturers to take apart a one-family unit, haul it to another locality, and put it up again, all in one day.

Construction Unit for U.S. Dept.

WASHINGTON—Establishment of a construction unit in the Bureau of Foreign and Domestic Commerce, Department of Commerce, was announced here July 21 by Director Carroll L. Wilson, who said the move was prompted "by a very evident need for a more complete and detailed analysis of current conditions in the construction industry."

Working with other government agencies in the correlation of statistical activities, the new unit will endeavor to develop, cooperatively, with government and industry, a statistical program designed to provide accurate and comprehensible data on all phases of construction in the United States.

S. Morris Livingston of Weston, Mass., has been appointed to direct the work of the new unit. Joseph H. Ehlers of Hartford, Conn., has been appointed technical assistant.

Boston A.C. Sales Mount

BOSTON—There has been considerable activity in the air conditioning field of the Boston metropolitan area lately, and many new installations are reported by the Air Conditioning Division of the Boston Edison Company. There are now a total of 1900 installations in the metropolitan area, representing over 19,000 horsepower applied to operation of the equipment.

One large installation for a new grocery store shortly to be opened in the heart of the shopping district by the S. S. Pierce Company, calls for over 50 hp. This is one of the oldest grocery firms in the country, doing a wholesale and direct importing business as well as retail. Seven restaurants and another store of the Liggett drug chain, which already has air conditioned several of its larger stores, are included in recent installations.

Cork Advisory Group Set Up

WASHINGTON—Selection of a nine-member Cork Defense Industry Advisory Committee was announced here July 14 by the Bureau of Clearance of Defense Industry Advisory Committees, Office of Production Management.

The committee was established by OPM to advise and consult with Dr. Harry S. Rogers of the priorities division, who has been designated government presiding officer of the committee.

Prizes for Design of Building

NEW YORK—A $3,750 prize competition for a design for the Brooklyn-Battery tunnel ventilation building, which will be built off Governors Island in the Upper Bay, was announced July 20 by the New York City Tunnel Authority, 200 Madison Avenue.

Pittsburgh Adopts Smoke Law

PITTSBURGH—An anti-smoke ordinance, designed to lift the pall from Pittsburgh in two years and expected to serve as a model for other Western Pennsylvania cities in eliminating the smoke nuisance from the entire area, has been given final approval by the City Council and signed into law here July 8 by Mayor Scully. Also enacted was an accompanying measure providing for enforcement through the establishment of a Bureau of Smoke Prevention.

Drafted by the Pittsburgh Smoke Commission after long months of study inspired by the success of anti-smoke efforts in St. Louis, the new ordinance will become partially effective Oct. 1, when industrial plants, business establishments, apartment buildings and hotels will be brought under its provisions.

Robert C. Farrington

CLEVELAND—Robert C. Farrington, 59, chief mechanical engineer of The Austin Company since 1919, died at Fort Worth, July 15, following a heart attack about two weeks ago. At the time of his death, Mr. Farrington was in Texas working on equipment details for the two huge windowless Army bomber plants now being erected at Fort Worth and Tulsa, Oklahoma.

R. C. Farrington

Mr. Farrington had been associated with Austin since 1918, when he joined the Austin organization as a mechanical engineer at the district office in Philadelphia.

Mr. Farrington was graduated from Syracuse University as an electrical engineer in 1903 and for the next two years was employed as engineer and estimator with W. N. Tobin in New York City. From 1906 to 1913 Mr. Farrington was engaged in professional engineering work, first in New York as a partner of Sorenson & Farrington, and subsequently in Syracuse under the name of Farrington & Berdsoll. In 1913 he became president and general manager of the York Engineering Company at York, Pa., and continued in that capacity until he joined the Austin organization.

Mr. Farrington was in charge of all mechanical engineering work on the huge $60,000,000 automobile city built by Austin for the Soviet in 1930, and returned home to supervise the working out of control facilities for the world's first windowless factory, which Austin designed and built for Simonds Saw & Steel Company at Fitchburg, Mass., in 1931. He is survived by his wife, a son and daughter.

Number of Degree-Days for June, 1941

HEATING & VENTILATING continues its thirteenth year of publishing degree-day data for various large cities. Forty-four cities have been added to the list of those previously published. A total of 114 cities are listed below.

	Degree-Days June, 1940	Degree-Days June, 1941	Deg. Days Season, 1940-41
Albany, N. Y.	87	44	7142
Alpena, Mich.	...	96	7688
Atlanta, Ga.	0	0	3102
Atlantic City, N. J.	...	32	4957
Baker, Ore.	...	192	6311
Baltimore, Md.	2	8	4387
Binghamton, N. Y.	...	53	6824
Birmingham, Ala.	0	0	2635
Bismarck, N. D.	...	105	8312
Boise, Idaho	...	122	5393
Boston, Mass.	75	61	6054
Buffalo, N. Y.	106	69	6921
Burlington, Vt.	115	68	8055
Cairo, Ill.	...	0	3822
Canton, N. Y.	...	66	8264
Charles City, Iowa	...	49	7069
Charlotte, N. C.	...	0	3239
Chattanooga, Tenn.	...	0	3675
Cheyenne, Wyo.	102	189	6938
Chicago, Ill.	52	55	6010
Cincinnati, Ohio	9	4	4856
Cleveland, Ohio	42	24	5894
Columbia, Mo.	...	10	4625
Columbus, Ohio	15	8	5240
Concord, N. H.	...	104	7169
Concordia, Kan.	...	10	5223
Davenport, Iowa	...	19	5779
Dayton, Ohio	...	13	5343
Denver, Colo.	33	98	5478
Des Moines, Iowa	0	28	5868
Detroit, Mich.	40	33	6349
Dodge City, Kan.	9	17	4726
Dubuque, Iowa	...	32	6325
Duluth, Minn.	230	222	8831
Eastport, Me.	...	321	8191
Elkins, W. Va.	...	33	5829
El Paso, Tex.	0	0	2348
Erie, Pa.	58	52	6239
Escanaba, Mich.	...	119	7929
Evansville, Ind.	0	5	4557
Fort Smith, Ark.	...	0	3072
Fort Wayne, Ind.	16	32	6027
Fort Worth, Tex.	0	0	2398
Grand Rapids, Mich.	46	30	6331
Green Bay, Wis.	88	71	7424
Greensboro, N. C.	...	3	4065
Harrisburg, Pa.	18	19	5381
Hartford, Conn.	77	45	6365
Helena, Mont.	105	139	7353
Huron, S. D.	...	74	7321
Indianapolis, Ind.	7	7	5125
Ithaca, N. Y.	75	55	6847
Kansas City, Mo.	5	5	4662
Keokuk, Iowa	...	8	5237
Knoxville, Tenn.	1	0	3625
La Crosse, Wis.	19	49	6921
Lander, Wyo.	...	141	7790
Lansing, Mich.	...	45	6785
Lincoln, Neb.	8	27	5635
Little Rock, Ark.	0	0	2924
Los Angeles, Calif.	11	14	1049
Louisville, Ky.	2	1	4264
Lynchburg, Va.	...	11	4017
Madison, Wis.	24	60	6978
Marquette, Mich.	...	201	7826
Memphis, Tenn.	0	0	3005
Milwaukee, Wis.	78	92	6715
Minneapolis, Minn.	29	65	7519
Nantucket, Mass.	...	124	5899
Nashville, Tenn.	1	0	3548
New Haven, Conn.	57	45	5810
New Orleans, La.	0	0	1215
New York, N. Y.	31	33	5230
Norfolk, Va.	0	4	3511
Northfield, Vt.	...	130	8568
North Platte, Neb.	...	60	5896
Oklahoma City, Okla.	1	0	3487
Omaha, Neb.	6	27	5742
Oswego, N. Y.	...	70	7101
Parkersburg, W. Va.	...	6	4941
Peoria, Ill.	2	4	5616
Philadelphia, Pa.	6	21	4861
Pittsburgh, Pa.	21	7	5300
Pocatello, Idaho	...	147	6632
Portland, Me.	150	139	6769
Portland, Ore.	40	78	3488
Providence, R. I.	58	46	5861
Pueblo, Colo.	...	53	5415
Raleigh, N. C.	...	2	3450
Reading, Pa.	16	24	5347
Reno, Nev.	30	119	5146
Richmond, Va.	1	8	4061
Rochester, N. Y.	66	42	7023
Roseburg, Ore.	...	105	3604
St. Joseph, Mo.	...	13	4982
St. Louis, Mo.	0	3	4322
Salt Lake City, Utah	31	73	5107
Sandusky, Ohio	...	18	5921
San Francisco, Calif.	173	154	2081
Sault Ste. Marie, Mich.	...	94	8388
Scranton, Pa.	57	49	6367
Seattle, Wash.	...	...	....
Spokane, Wash.	41	115	5582
Springfield, Ill.	1	0	4984
Springfield, Mo.	...	9	3757
Syracuse, N. Y.	64	50	7074
Tacoma, Wash.	...	122	3981
Terre Haute, Ind.	...	2	4932
Toledo, Ohio	28	23	6073
Trenton, N. J.	20	29	5331
Utica, N. Y.	77	77	7361
Washington, D. C.	6	8	4440
Wichita, Kan.	6	3	4535
Yakima, Wash.	...	51	4922

(...) Indicates data not available.

AIR CONDITIONING MAINTENANCE PROCEDURE

CENTRAL SYSTEMS

REFRIGERANT CIRCUIT AND CONTROLS—the part of the systems through which the refrigerant circulates including the compressor, connected piping and valves, condenser, receiver, and evaporator. The controls consist of such devices as thermostatic expansion valves, switches and regulators with automatic cut-outs and solenoid valves for water and refrigerant.

LEAKING GLANDS—When repairing compressors, valves and fittings, leaking glands should be tightened only to the point where the leak stops. If it is necessary to replace the packing, the system may have to be pumped down.

PUMPING DOWN—If the leaks are on the low side, the liquid line valve is closed and the compressors operated until a vacuum of 20 to 25 in. is reached. This forces the refrigerant into the receiver. In some cases where the system is to be open only for a short period it is possible to prevent leakage of air into the system, or leakage of refrigerant out by lowering the pressure to atmospheric pressure before the system is opened. After the repair is completed carbon dioxide may be used for testing for tightness. Where air is allowed to get into the system the system will have to be purged after operation is resumed. In making a repair to the high side of the system the refrigerant is pumped into the low side. In most cases it is not possible to pump all the refrigerant into the low side and therefore it is necessary to draw some of the refrigerant into drums temporarily. Only drums intended for such storage should be used.

REFRIGERANT STORAGE IN DRUMS—The drum is laid on a slant and connected to the refrigerant valve in the receiver with a flexible connection. The refrigerant flows into the drum by gravity. If the drum is kept in an ice bath, refrigerant will be speeded. The drum should be filled only to its stamped capacity. The amount of refrigerant in drum can be checked by placing the drum on a scale and noting the weight increase. After refrigerant is replaced and operation resumed the system should be purged.

PURGING SYSTEM—The best way to purge the refrigerant circuit is to first settle out the system to permit all foreign gases and air to rise to the high, or purging point of the system. With pressure on the system the purge valve is opened until refrigerant shows; it is then closed.

REPLACING REFRIGERANT—When additional refrigerant must be added to the system this is done by connecting a refrigerant drum to the suction side of the system in such a way that no liquid refrigerant can enter into the compressor. When conditions permit a warm bath around the drum will speed up the charging. The amount of refrigerant necessary can be determined by watching the head pressure.

SCALE TRAP CLEANING—System should be pumped down, if necessary, scale trap cleaned and the system should be put back into normal operation. After a short period of operation, air should be purged.

EXPANSION VALVES—To check the operation of expansion valves, the valve should be removed and connected to a cylinder of the refrigerant with the bulb hanging free. Refrigerant will be passed through the outlet of the valve when refrigerant drum is open. Placing the expansion valve bulb in the refrigerant stream should cause the valve to close.

MOISTURE—To remove moisture from the refrigerant a dehydrator of activated alumina, silica gel, or similar substance, should be installed. Dehydrators should be removed after about two weeks because they serve no purpose after the moisture has been removed.

SAFETY DEVICES—Fusible plug in liquid receiver should be renewed at least every two years. Relief valves can be tested by removing them from the system and checking them with compressed air or water. If water is used it must be perfectly clean and free from solid matter which might injure the valve. It should be noted whether safety devices of all types comply with local ordinances covering such devices. The operator should always be sure that protective devices will pass inspection.

CONDENSING WATER CIRCUIT—the part of the system through which the condenser cooling water circulates. It consists of condensers, water piping, floats and valves. If the water is recirculated it may include spray or cooling ponds, cooling towers, settling tanks, and collection pans; or it may include an evaporative type condenser.

STRAINERS—devices to catch foreign matter; they are often a protective device. Strainers should be examined for signs of wearing or warping in such a way that they might become an obstruction in the line. They must be kept clean.

VALVES—Periodical flushing with clean water under pressure is necessary to keep the valves clean even though strainers are placed ahead of the valves. When valves become pitted they should be ground in with a fine abrasive. After any repairs the water valves should be adjusted so that they close when the unit is shut down.

CONDENSER—Condenser should be cleaned mechanically once a year and thoroughly washed with clean water. Tools which are likely to damage the tubes should not be used, nor should the tubes be bulged. A cleaning "brush" should be used for mechanical cleaning. For prolonged lay-up periods condenser should be left completely dry on the water side.

TANKS AND PANS—Any tank and pan used in a condensing water system should be kept as clean as conditions will permit. During lay-up periods tanks should be first cleaned then laid up dry. Where tanks show signs of deterioration or corrosion, a coat of corrosion resisting paint should be applied.

EVAPORATIVE CONDENSERS—If ordinary flushing of the tubes does not completely clean them, other methods may have to be used. A caustic solution forced through a spray gun in which air pressure is used to spray, or in which steam is mixed with the caustic, will effectively remove stubborn scale. There are a number of commercial solutions, with caustic bases, which need no preparation other than the addition of heat. These solutions can be reclaimed and used again.

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H. & V.'s REFERENCE DATA—203

AIR CONDITIONING MAINTENANCE PROCEDURE

COOLING WATER SYSTEM—the circuit through which the refrigerated water passes. Includes storage tanks, evaporators, piping, spray units or washers, and collection pans and heating coils.

COOLING WATER—Water should be changed frequently otherwise it may develop odors that will be carried into the air conditioning spaces. In using deodorants, care should be taken to prevent an overdose. The pH concentration of the water should be watched to maintain it at the proper point. Addition of chemicals to the water may be necessary to establish the proper pH. Where slime persists in forming, even with frequent cleaning, a chemist should be consulted in methods of preventive treatment.

SPRAY NOZZLES—Nozzles must be kept clean. To do this, nozzles, or a complete bank of nozzles including the header, should be removed and blown out backwards with compressed air.

FILTERS AND DUCTS—the part of the system which cleans and carries the air of the system. Because of their structural nature they require less attention than other parts of the system.

FILTERS—Oil dipping filters should be cleaned with hot caustic solution; they are then washed with hot water or blown with clean, live steam. After cleaning they must be dried well. The oil dipping should give a thin film over all the surfaces after a period of draining to remove the excess oil. After cleaning filters should be thoroughly washed with clean water and dried and are then ready for dipping in an oil. Filters must be well drained before they are replaced in a filter bank. Throw-a-way filters should be replaced according to the manufacturer's recommendations or when static pressure drop is more than 0.25 in. of water. Dry filters should be cleaned according to the manufacturer's directions.

DUCTS—Ducts can be blown out but vacuum cleaning is preferred because of better control of cleaning. Unusually large accumulations of dust and dirt in a particular part of an otherwise clean duct may indicate improper contour at that point. Dirt-laden ducts mean poor filtering and washing.

DAMPERS—Dampers should operate smoothly, which means that piston drives must be free from air leaks that might cause sluggish operation. Dirty parts of such drives should be washed in a solution such as carbon tetrachloride to clean them. Orifices and parts should not be scraped since they may be enlarged by such treatment.

ROTATING APPARATUS—those parts of the air conditioning system, such as pumps, compressors, blowers, motors, and the controlling devices which convert or assist in the conversion of electrical energy into refrigeration.

COMPRESSORS—Only lubricants recommended by manufacturer should be used. Oil taken from separators should not be replaced in the system until it has been properly filtered. Packing glands should be tightened only enough to prevent leakage and only soft packing should be used. Where conditions permit, bearings should be opened once a year and the oil grooves cleaned out. Oil piping also should be cleaned. Cross head and connecting rods should be carefully checked for cracks and for signs of unusual wear. The whitewash test is highly useful for locating cracks. The part to be tested is first soaked in oil and then cleaned dry. Whitewash is applied and left to dry. After complete drying, the part is tapped with a hammer and oil will ooze from any cracks in the part and can be easily traced in the whitewash. Whenever possible, repairs should be made by welding.

BELTS—During long lay-up periods belts should be removed and wrapped in a protective covering. They should be stored away from the heat and in a dry place. No dressing should be applied unless specifically called for by manufacturer's instruction. Unusual wear of belts can be traced to misalignment.

MOTORS—Cooling air passages through motors should be kept clean. Broken brushes are an indication of high spots on the commutator. Motors should be kept covered when not in use. Starters on motors should have all contacts free from arcing during the starting cycle.

WATER PUMPS—Small water drips from pump packings should be disregarded. As a matter of fact many manufacturers specify this condition for good operation. Pump packing which is too tight may injure the shaft. When pump is to be idle for an extended period, packing on pumps should be eased off and all exposed parts should be covered with grease.

GEARS—Gear boxes should be well lubricated with the proper grade of oil. They should be washed out and oil renewed each year unless otherwise specified. Attention should be paid to the drives to see that they are kept in good condition.

UNIT AIR CONDITIONERS

UNIT AIR CONDITIONERS—self-contained air conditioning systems that are built in compact units.

PIPING—Flared joints in the piping or tubing should be protected from moisture formation by a coating of grease such as vaseline. Moisture which freezes will cause cracked nuts or flared ends of tubing and result in leaks.

MOTORS AND FANS—In replacing motor bearing oil, unless otherwise recommended, SAE No. 10 or No. 20 should be used on small motors. Cleaning of small motors is of considerable importance. Belt tension should be maintained at the proper point.

COOLING COIL—Cooling coil should be kept clean at all times since the dirt will not only reduce the efficiency but also may cause odors. Coils may be cleaned by washing with a caustic soda solution and rinsing with clean water.

CONDENSERS—Air cooled condensers should be cleaned frequently by compressed air. Tower type condensers may be cleaned by water under pressure.

AIR FILTERS—Air filters should be replaced when they become dirty and a static pressure gauge should be used to determine when filters should be renewed.

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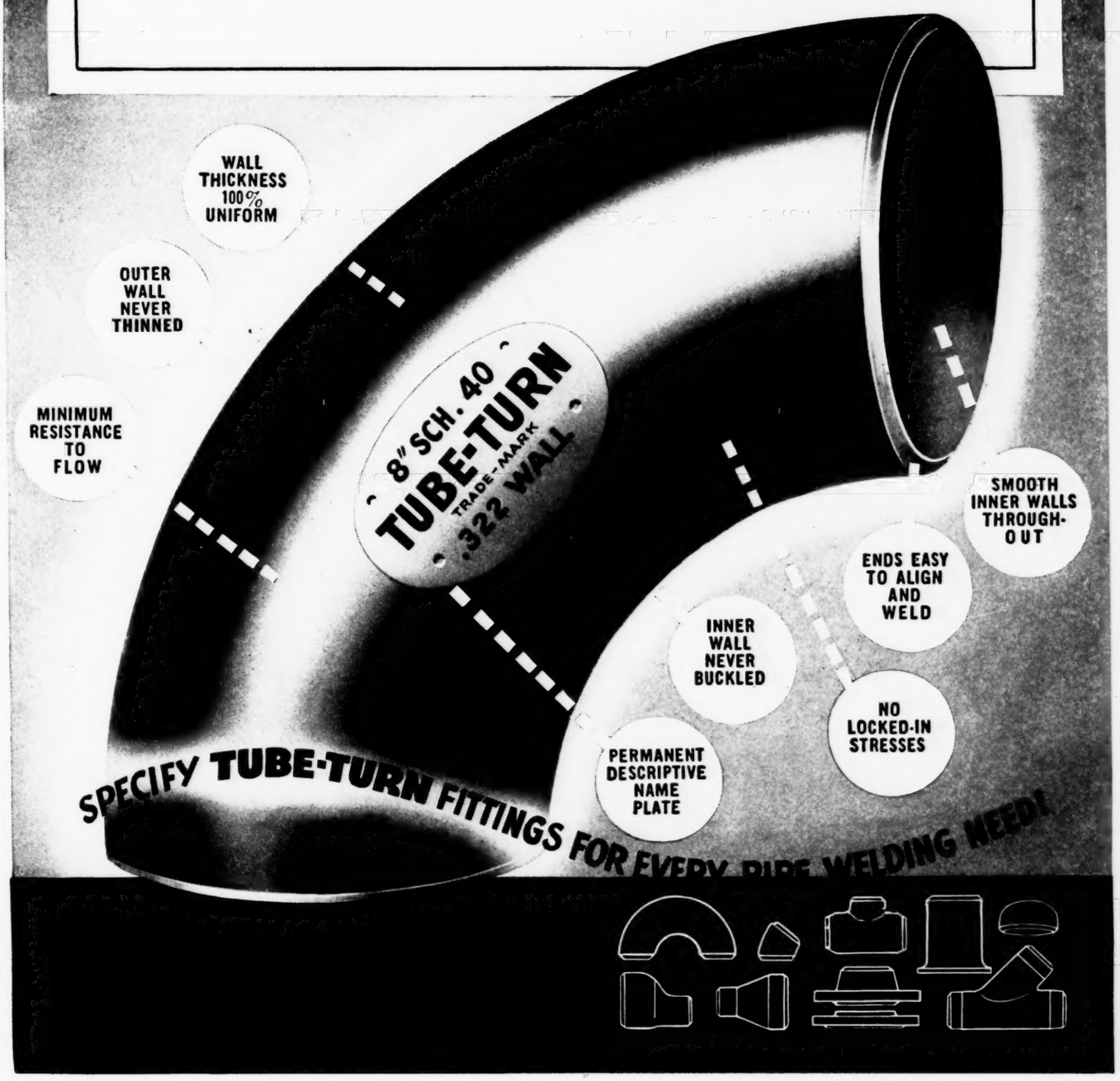

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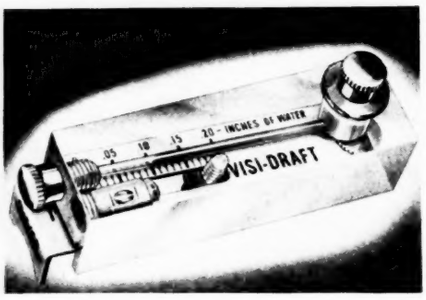


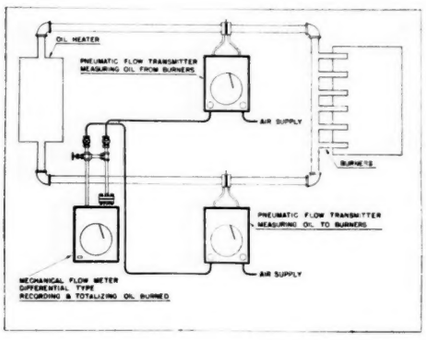
Low cost portable draft gage.

Dwyer Draft Gage

NAME—Dwyer Visi-Draft gage.
PURPOSE—For measuring draft.
FEATURES—Draft gage is constructed of block of crystal clear plastic with all holes drilled and reamed. Manufacturer states that readings can be taken from above making it possible to place instrument on table or floor and that location of the scale directly below and close to the indicating tube eliminates the possibility of error from parallax. A leveling bubble is set in a polished bore in the body so that it is visible from all angles. Gage comes in a carrying case measuring 4 x 3 x 1 in.
RANGE—0.05 to 0.20 inches of water in 0.01 inch divisions. Price, $5.85.
MADE BY—*F. W. Dwyer Mfg. Co., 565 W. Washington Blvd., Chicago, Ill.*

Brown Differential Transmitting Systems

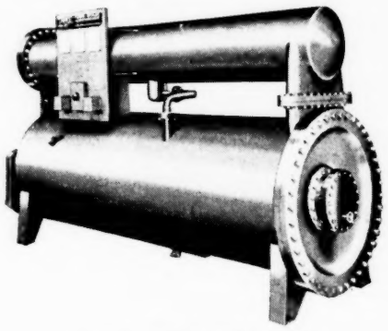
NAME—Brown Differential New-Matic transmitting systems.
PURPOSE—For measuring differences in temperatures, flows, levels and pressures.
FEATURES—The system is said to be useful for many applications such as controlling, indicating or recording (1) difference in inlet and outlet temperature on feed water heaters, condensers, air pre-heaters or heat exchangers; (2) difference in inlet or outlet temperatures of water for heating or cooling of buildings or tanks; (3) difference in wet and dry bulb temperatures; (4) difference in flows from reservoirs, boilers, or tanks; (5) difference in levels in two remote tanks, and (6) difference in pressures. The system consists of two pneumatic transmitters both of which may be actuated from thermometer bulbs, pressure elements, level meter bodies or flow meter bodies. The transmitter sends pressure changes to the receiver by means of a small diameter copper tube. A receiver can be located at distances as great as 1000 ft from the transmitter without any appreciable lag in the recording. Receiver is essentially similar to the Brown Mechanical Flow Meter and the pressures from the two transmitters are applied to each side of a mercury U-tube in which is located a float that is linked to a recording pen. Manufacturer states that the outstanding features of the system are that large and small differentials can be measured and controlled, that differential instrument can be 1000 ft from transmitters, that long lengths of capillary tubing are eliminated, and that all instruments are standard equipment and all differential linkages are eliminated to insure trouble-free operation and decrease maintenance.
LITERATURE—Bulletin 94-4.
MADE BY—*The Brown Instrument Company, Division of Minneapolis-Honeywell Regulator Co., Philadelphia.*


OIL HEATER
PNEUMATIC FLOW TRANSMITTER MEASURING OIL FROM BURNERS
AIR SUPPLY
BURNERS
PNEUMATIC FLOW TRANSMITTER MEASURING OIL TO BURNERS
AIR SUPPLY
MECHANICAL FLOW METER DIFFERENTIAL TYPE RECORDING & TOTALIZING OIL BURNED

Brown Differential New-Matic fuel measuring system.

Trane Heating and Air Conditioning

NAME—Trane Turbo-Vacuum compressor, 50-ton model; self-contained air conditioner, 15-ton model; 1941 cooling coil line and Trane float trap.
PURPOSE—New equipment for use with heating and air conditioning systems.
FEATURES—Trane Company announces a number of additions and changes in its line of heating and air conditioning equipment. Among the additions is a new 50-ton size of the Trane Turbo-Vacuum compressor which is similar in construction to the 70- to 200-ton sizes which are now available. This unit is designed for supplying chilled water for comfort cooling and process work. It is said to be ideal for stand-by service since a snap of the switch starts the machine. The second addition to the line is a 15-ton self-contained air conditioner. Manufacturer states that outside air as well as recirculated air can be introduced into the unit and that it may be arranged in a regular central system incorporating an evaporative condenser. The new Trane cooling coil line for 1941 is said to incorporate a number of new features. This line consists of type R cooling coils designed specially for cold water in which sediment may occur; type DE coil designed for applications where

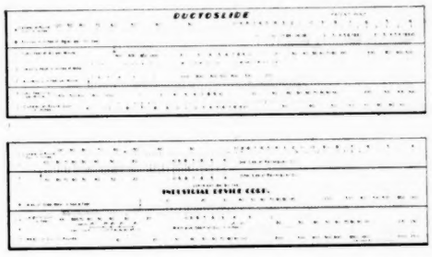


50 ton chilled water cooler.

direct expansion refrigerants such as Freon or methyl chloride is used and the type OS coils which are designed for use with average quantities of clean water. Also announced at this time is a new refinement in Trane float traps. These float traps are built in models for service on both high and low pressure steam systems. The smaller model low pressure traps are equipped with brass seats and plungers while the heavy duty traps have silchrome seats and plungers. For high pressure duty all traps are equipped with silchrome seats and plungers.
LITERATURE—Turbo-Vacuum compressors, bulletin S 399; self-contained air conditioning bulletin, DS 362; cooling coils, bulletin DS 365, and float traps, bulletin S 260.
MADE BY—*The Trane Company, La Crosse, Wis.*

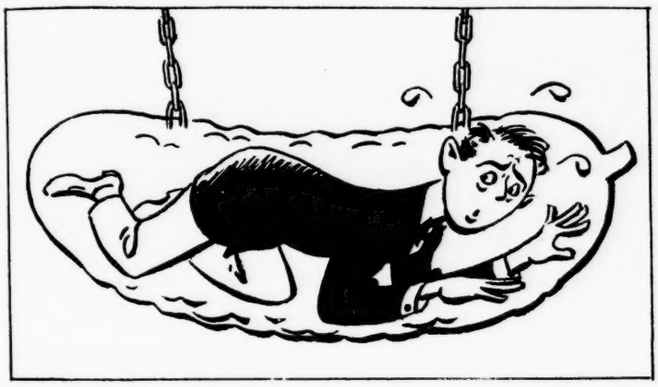
Industrial Device Slide Rule

NAME—Ductoslide.
PURPOSE—For use in designing air distribution systems.
FEATURES—Ductoslide consists of 7 scales on the front face and 7 scales on the rear face. It is said to afford a simple, fast and accurate means of solving for the following: cfm to be delivered; static head in inches of water; air velocity in feet per minute; velocity head in inches of water; sizes of round and rectangular ducts in inches; area of sheet metal for a given length of duct; total weight of sheet metal in pounds for a given length of duct, and gage of sheet metal.
MADE BY—*Industrial Device Corp., 501 Fifth Ave., New York, N. Y.*

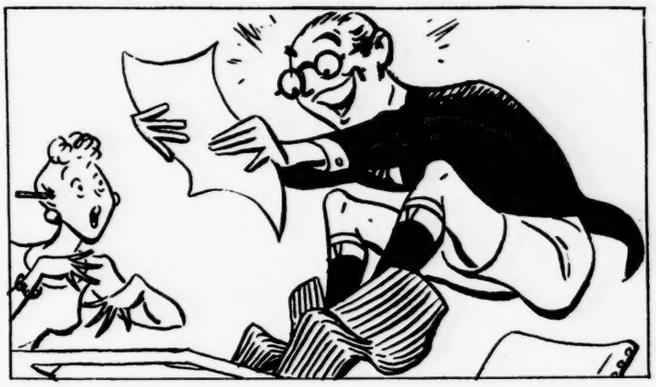


For solving air distribution problems.

Tips on dirt-defying Dust-Stops!

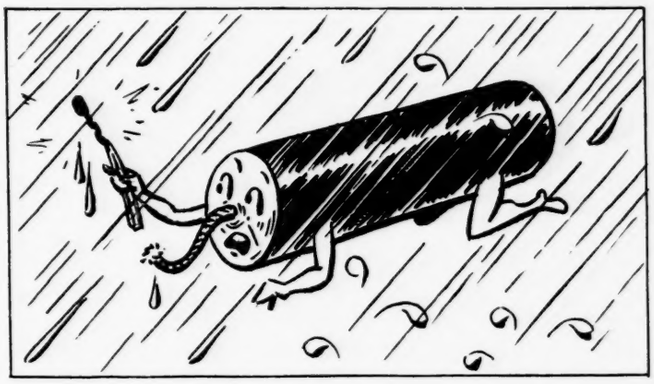


1. Why be in a pickle with inefficient air conditioning? Dust-Stop* Air Filters stop virtually all "nuisance" dusts *and* pollens! Capacity: 2 CFM per sq. in. of area at 300 FPM. Average resistance, new (in inches of water gauge): .062 for 1-inch thickness; .13 for 2-inch. And . . .



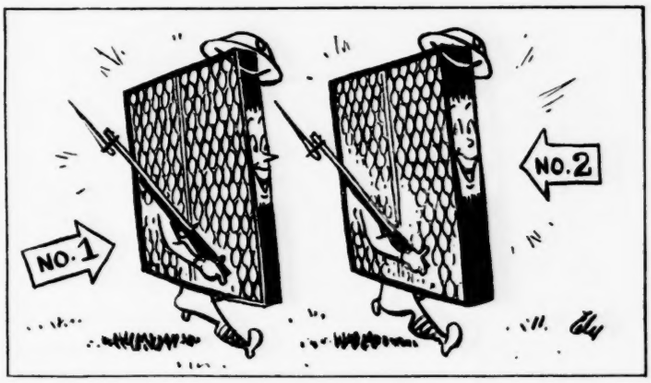
2. Treasurers jump out of their pants in surprise at the economy of Dust-Stops. They cost about 1¢ per CFM to install complete, and only *one-tenth* of a cent per CFM to replace when filters need changing. You haven't heard anything yet . . .

3. Do you ever get the screaming-meemies over the expense of changing filters? Well, Dust-Stops require *no* skilled work. Anybody can change them; and they eliminate washing, charging, draining, etc. There's no need for you to keep a supply of spares on hand!



4. Like a firecracker in the rain, neither the glass fiber filtering element nor the special adhesive in Dust-Stop Air Filters will support combustion. This adhesive is used on no other air filters, and . . .

5. You'll be running around in circles if you ever try to find signs of bleeding. You won't find any. The Dust-Stops adhesive leaves no droplets inside your ducts or on your walls! What does it all add up to? *THIS:* Pick up your telephone and ask for . . .



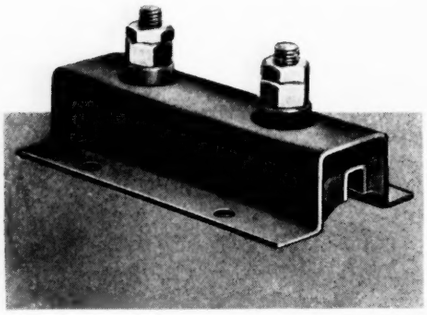
6. Replaceable Dust-Stops! They come in two thicknesses, No. 1 (1-inch) and No. 2 (2-inch). You can order them from your own air-conditioning manufacturer, jobber, or dealer. Or write to us! *Owens-Corning Fiberglas Corporation, Toledo, Ohio.*

FIBERGLAS* DUSTOP* AIR FILTERS

*T.M. Reg. U. S. Pat. Off.

Made by Owens-Corning Fiberglas Corporation, Toledo, Ohio

DIRECT CANADIAN INQUIRIES TO FIBERGLAS CANADA LIMITED, OSHAWA, ONTARIO



Korfund Rubber-In-Shear Isolator.

Krofund Vibration Isolators

NAME—Korfund Rubber-In-Shear and Korfund Rubber-In-Compression.

PURPOSE—For isolating vibration from reciprocating and rotating machinery.

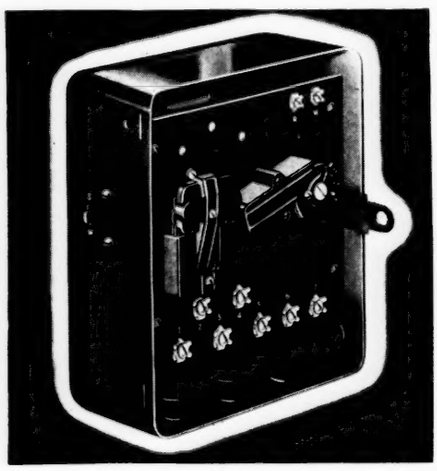
FEATURES—These isolators are designed for use with small engines and relatively lightweight machinery. The Rubber-In-Shear model is designed for load capacities for individual units from 25 to 450 lb. If necessary, two or more of these mountings may be combined in steel housings when greater load capacities are required. The Rubber-In-Compression model is said to be suitable for concentrated loads. Both top and bottom steel sections are securely bonded to the circular rubber stock. Load capacities range up to 1200 lb per mounting. If desired this unit may also be used as a shear mounting by bolting the base plate in a vertical position.

MADE BY—*The Korfund Co., Inc., Long Island City, New York.*

Penn Stoker Control

NAME—Air conditioning stoker timer relay, type 561SW.

PURPOSE—A summer-winter stoker control which in the winter provides hold-fire operation of the stoker as well as simultaneous fan and stoker operation at the command of the room thermostat and during summer allows the furnace fan to operate for air circulation.



Summer-winter control for stoker fired furnaces.

FEATURES—Manufacturer states that only three controls are required for positive year-round regulation of stoker and furnace fan operation on stoker fired forced warm air systems. The key to this simplified control system is the air conditioning stoker timer relay. The only other controls required are a type No. 870 heat actuated thermostat, and type 515AT04D combination limit and relief fan control. This latter unit provides for all bonnet switch functions in one unit and requires only mounting and wiring of one control. During the winter the system will control fan and stoker operation as well as provide the hold-fire control when stoker is not operating. During the summer the system will cause the furnace fan to operate when the house temperature goes above the setting of the room thermostat. Automatic day-night control may be included in the system by the addition of the type 772 Tem-Clock.

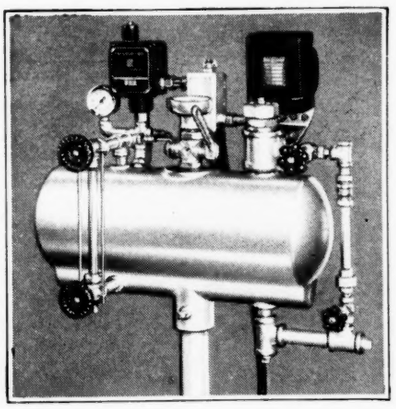
MADE BY—*Penn Electric Switch Co., Goshen, Indiana.*

Pressure-Jet Steam Conditioning

NAME—Pressure-Jet.

PURPOSE—For cleaning and preventing corrosion in steam heating systems.

FEATURES—The Pressure-Jet unit is designed to be connected by means of a ⅛ in. copper tube to the header or steam main of the heating system. In operation the unit discharges into the heating system under high pressure the Pressure-Jet fluid which is said to immediately flash into vapor. This vapor is said to combine with the steam and is carried to all parts of the system. It is claimed that the fluid is essentially alkaline in nature and is not injurious to ferrous or non-ferrous metals, packings, or gaskets. Manufacturer states that the existing scale, sludge, or rust, and other products of corrosion are separated into minute particles which are held in suspension, causing flow-off as a liquid with the condensate. After all scale, oil sludge, rust, and corrosion is removed the alkaline action of the vapor is said to neutralize the activity in the system and prevent further rusting or corrosion. Foreign matter brought down with the condensate is discharged into the sewer in plants having central heat. In individual systems the condensate is returned to the boiler where the dirty returned water is replaced in the ordinary process of blowing down the boiler. Operation of the Pressure-Jet unit is said to be entirely automatic and an automatic liquid level switch controls the current to the electric heater element in the unit, turning it on when the Pressure-Jet unit is filled and off when the treatment has been discharged. A pressure control switch is provided to maintain the desired pressure. The rate of discharge is controlled by adjusting a needle valve.



For cleaning and preventing corrosion in steam heating systems.

MADE BY—*Pressure-Jet Corporation, 631 E. Center St., Milwaukee, Wis.*

Autovent Propeller Fans

NAME—Allvent.

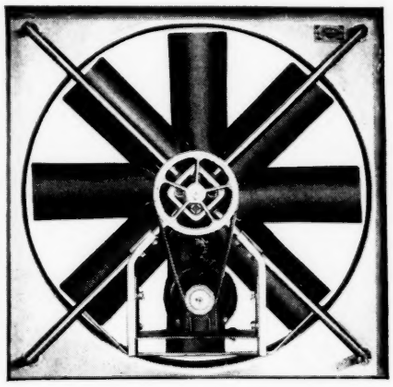
PURPOSE—A low cost, all purpose, quiet operating fan for industrial and commercial application.

FEATURES—In this improved model the blade assembly has been designed to overcome normal restrictions in the air flow, to prevent churning the air, and to absorb shocks and sudden changes in air loads that ordinarily overtax motor capacities. Fan operates with V-belt drive from standard speed 1725 rpm motor. Units up to 36 in. diameter have 6 blades, sizes up to 54 in. have 8 blades. Panel has 1½ in. flange with holes punched for mounting. Fan bears certified ratings of the NAFM.

CAPACITIES—5,000 to 23,000 cfm.

LITERATURE AVAILABLE—Bulletin 206-A.

MADE BY—*Autovent Fan & Blower Co., 1805-1827 No. Kostner Ave., Chicago, Ill.*



For industrial and commercial applications.

Who pays your "*Mistake-insurance*" premium?

INCOMPLETE or hard-to-read identifying marking on welding fittings costs users time and money. Dealers may deliver Standard Thickness for Extra Strong. Welders and Fitters may have to measure and "mike" fittings just to make sure.

But not with WeldELLS. Or any other Taylor Forge Fittings. For every one carries complete, legible and *permanent* marking*. You know at a glance just what size and thickness you're handling. You're sure of getting exactly just what you order and you save time and trouble on the job.

Of course it costs something to mark Taylor Forge Fittings in this permanent way. But our paying this "mistake-insurance" premium for you is simply a matter of following long established Taylor Forge principles: *First, sound engineering design; then maximum utility, convenience and economy.*

So here is another extra-value feature that's "on us"—for despite this, and the other extra-value features listed opposite, WeldELLS cost no more.

● **Write today** for new 216 page catalog 401. It contains full information about America's most complete line—and best engineered line—of welding fittings.

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

*Since the marking is pressed into the metal before forming, and since the manufacture of the fittings is carried out at a forging temperature, each in effect receives a heat treatment after the operation. The indentations have no sharp corners or edges and the marking has no effect on the strength of the fitting.

OTHER *Extra-Value* FEATURES

What can be asked for in welding fittings that WeldELLS do not have? No other fittings for pipe welding combine these eight features. In addition to Permanent Markings these features are:

1. Seamless—greater strength and uniformity.

2. Tangents—keep weld away from zone of highest stress—simplify lining up.

3. Precision quarter-marked end—simplify layout and help insure accuracy.

4. Selective reinforcement — provides uniform strength.

5. Wall Thickness never less than specification minimum—assures full strength and long life.

6. Machine tool beveled ends—provides best welding surface and accurate bevel and land.

7. The most complete line of Welding Fittings and Forged Steel Flanges in the World—insures complete service and undivided responsibility.

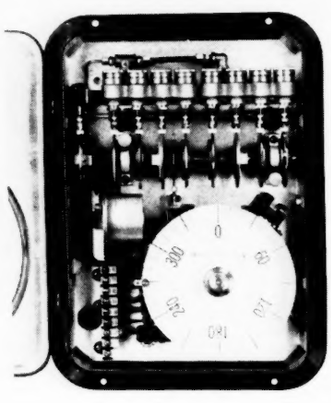
For continuous measurement of stack, temperature, draft and CO_2 content.

Weaver Heating Plant Analyzer

NAME—Heating plant analyzer.
PURPOSE—For measuring stack temperatures, draft, and CO_2 content of flue gases.
FEATURES—It is said that this instrument will give instantaneous and continuous readings of stack temperature, draft, and CO_2 content of flue gases. The entire instrument is enclosed in a leatherette case which opens to reveal the three dials. Manufacturer states that the instrument is entirely electric and employs no liquids or chemicals and does not require leveling before analysis is begun. It is said that the draft can be measured within ½ of 1/100 of an inch of water, temperature within 2% of absolute correct reading, and CO_2 within ½ of 1%. All readings can be taken simultaneously.
MADE BY—*Weaver Manufacturing Company, Heating Plant Division, Springfield, Ill.*

Bristol Time Cycle Control

NAME—Model A-118 Impulse-Sequence Cycle Controller.
PURPOSE—For timing mechanical operations in industrial processes.



For timing industrial processes.

FEATURES—This instrument is designed for use on plant processes where a number of factors must be accurately timed according to a fixed program. In operation the controller is said to actuate or engage at exactly the correct time in each cycle the necessary mechanical, electrical, or pneumatic devices for automatically carrying out the intended schedule. Timing is accomplished by a Telechron-driven aluminum disc on which is printed a 25-inch scale. The desired schedule of operations is incorporated into the controller by punching holes with an ordinary ticket punch on the time scale. The location of these holes determines the time of operation of the cam mechanism. Discs for new cycles or schedules of operation can be easily made. All controllers are drilled for eight cams and pilot valves.
LITERATURE—Catalog 572.
MADE BY—*The Bristol Company, Waterbury, Conn.*

Storage Water Tank Thermotrol

NAME—150 Series Storage Water Tank THERMOTROL.
PURPOSE—Direct acting thermostatic control for storage water heating tanks to regulate flow of steam or water.
FEATURES—Manufacturer states that this low-cost, self-contained, self-powered temperature control is adaptable to most tank and process applications. Suitable for pressures 0 — 125 lbs. it is available in sizes ½ in., ¾ in., and 1 in. and temperature ranges from 100F to 300F. The valve is said to be small and fast-acting and will control storage water heater temperatures within 5F plus or minus. Valve body is of cast, virgin steam brass. Control is tight-closing, single-seated, semi-balanced with corrosion-resistant bronze valve disc and seat.
MADE BY—*Sterling, Inc., 3732 N. Holton Street, Milwaukee, Wisconsin.*

Russell Radiator Valve

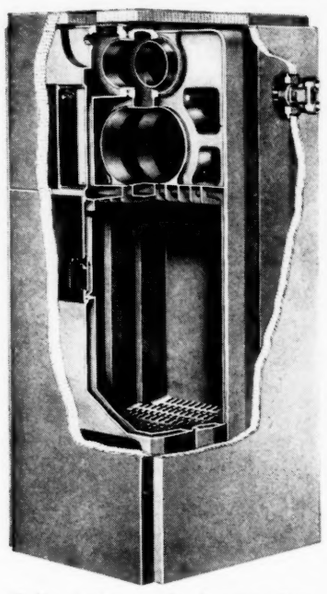
NAME—Dialon Warco 81 valve.
PURPOSE—Adjustable vent valve for allowing air to escape from steam systems.
FEATURES — Manufacturer states that chief feature of this valve is its micrometer accuracy of adjustment and controlled uniform rate of venting which takes place at each setting of the dial. A numeraled face on the dial shows 10 different venting spots and a crescent shaped slot at the top shows the extent of adjustment made. Each number on the dial is said to represent a change in venting rate 60% higher or lower than the next number. When set at a maximum the manufacturer claims that the Dialon is one of the fastest venting valves on the market. It is said that the

Adjustable rate vent valve.

drainage arrangement makes it drip-proof. Valve is furnished in crinkle black finish with a chrome plated dial house.
MADE BY—*W. A. Russell and Company, Bridgeport, Conn.*

Columbia Boilers

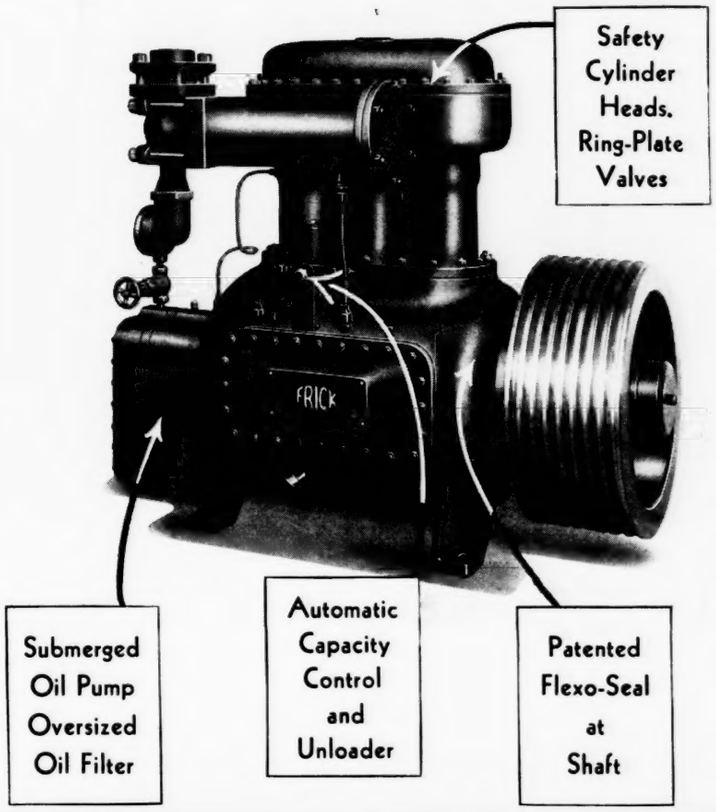
NAME—Coalsaver, Jr.
PURPOSE—A hand-fired coal burning boiler for supplying steam or hot water for small homes.
FEATURES—Manufacturer states that this unit is designed specially for high efficiency and features ash-pit water circulation which permits installation on wooden floors and produces maximum heat efficiency. It is also stated that because of low water entry ports this boiler can be used for gravity systems in small homes without basements. Other features include dust-seal doors, fully concealed damper and regulator, full 4-ply air-cell insulation, large fuel capacity and Taco hot water heater connections.
MADE BY—*Columbia Radiator Company, McKeesport, Pa.*



Boiler features ash pit water base.

Distinctive Advantages Announced for the New

Eclipse Refrigerating Machines


Safety Cylinder Heads. Ring-Plate Valves
FRICK
Submerged Oil Pump Oversized Oil Filter
Automatic Capacity Control and Unloader
Patented Flexo-Seal at Shaft

Don't buy ANY Freon-12 compressor until you've seen the new Frick Eclipse line! Built in three sizes, these phenomenal machines give capacities up to 60 tons refrigeration . . . in units so compact, light, efficient, and quiet they can be installed almost anywhere . . . and at a material saving over older types!

Only in the Eclipse line can you get all the exclusive advantages shown, plus such features as higher operating speeds (up to 900 r.p.m.), force-feed lubrication throughout, direct-connected motor drive when desired, two machines operating together (using the Frick oil-equalizing system), pistons with 5 rings, etc., etc. Nearly 60 years' refrigerating experience built into them.

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FRICK CO.
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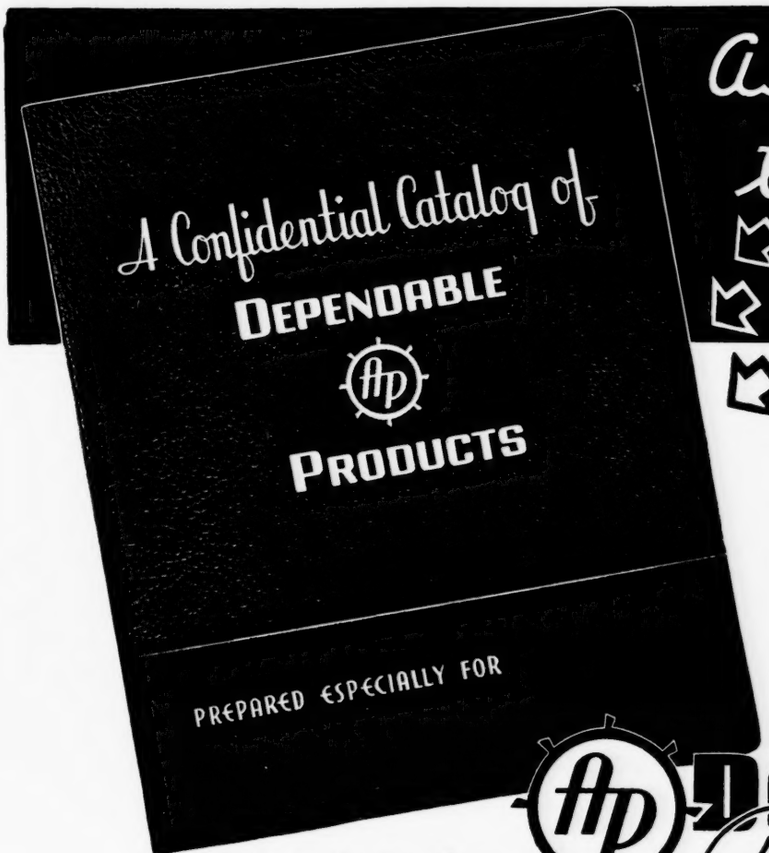

Ask Your Jobber to show you THIS BOOK!

This unique book, the first of its kind in the industry, shows the step by step construction of the "Dependable" A-P Expansion Valve. It will be worth your time to see this interesting demonstration at your jobber's store. Building the valve before your very eyes it conclusively proves the many reasons for A-P "Dependability."

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Progressive Service Men Use and Recommend — and Aggressive Jobbers Stock and Talk — A-P Products.

A-P DEPENDABLE Refrigerant Valves

WITH THE MANUFACTURERS

Bell & Gossett Co., Chicago, Ill., has erected a new and enlarged plant at Morton Grove, Ill., suburb of Chicago. The factory is being built on a twenty acre plot, allowing for future expansion. The plant is located

on the main line of the Milwaukee Railroad and contains 70,000 sq ft of floor space. The wall construction is novel, consisting of hollow bricks laid double. The plant will be heated by the company's hot water system and the offices will be air conditioned. Danel and Weidemeyer are the architects and engineers.

J. C. Kjerner

E. J. Moran

Fedders — New York Company with offices at 415 Lexington Ave., New York, has been formed by *John C. Kjerner* to serve the Metropolitan area. The company will act as manufacturers representatives for the Fedders, New York Blower, and Scott Valve lines. Associated with Mr. Kjerner will be *Eugene J. Moran*, formerly of Moran & Brown, and long associated with the Fedders account in Metropolitan New York. Mr. Kjerner began his career with Baker, Smith & Co. and was later a partner and vice-president of A. F. Hnrichsen, Inc. For the past three years he has been connected with the New York office of the Trane Company.

The Torrington Manufacturing Co., Torrington, Conn., has published a brief folder calling attention to the paradox of its being "Snowed Under in June"—referring to the unprecedented rush of orders being experienced by the company. To meet the demand a 20,000 sq ft new building is being erected in Torrington and is to be finished by October. The company has, however, every hope and expectation that its present difficulties in meeting deliveries will be overcome within a few weeks.

The Condenser & Heater Manufacturing Corporation has been incorporated in Buffalo, N. Y., with a capital of $5000. Incorporators are *Scott C. Ross*, Buffalo; *Eugene P. McCue*, Long Island City, and *Frederick T. Shea*, Brooklyn.

Servel, Inc., Evansville, Ind., has purchased the *Gas Appliance Division* of the *American Bosch Corporation*. The purchase includes all of the facilities now located at Springfield, Mass., for the manufacture of gas water heaters. These facilities are being moved to Evansville.

Viking Air Conditioning Corp., Cleveland, Ohio, which, as reported on these pages last month, recently experienced a fire which destroyed this factory, has moved to new quarters at 5600 Walworth Avenue, Cleveland, effective August 1.

Penn Boiler & Burner Mfg. Corp., Lancaster, Pa., has moved into a new modern factory building. The company's president, *E. C. Stauffer*, is one of a family which has for over sixty years been connected with the manufacture of boilers for domestic heating.

PERSONALS & PERSONNEL

C. W. Pearsall has been appointed general sales manager of *Ahlberg Bearing Company*, Chicago. Known to his friends as "Duke", Mr. Pearsall joined the Ahlberg organization in 1919 and has successively been a salesman in Chicago and Philadelphia, then Philadelphia branch manager, later Chicago branch manager, and after that manager of Distributor sales.

Edmund R. Walker has been promoted to assistant general manager of Fedders Mfg. Co., Buffalo, N. Y. He was formerly the manager of the air conditioning division. His broad experience in engineering, designing, manufacturing and marketing well qualifies him for his new assignment.

Henry Knowlton has been appointed sales promotion manager of Airtemp Div., Chrysler Corp., Dayton, Ohio. Mr. Knowlton will study the application of air conditioning, refrigeration, and heating equipment to selected vocational fields as part of the company's new dealer development and field training program. For the past four years Mr Knowlton has been a member of the editorial staff of *Air Conditioning & Refrigeration News*.

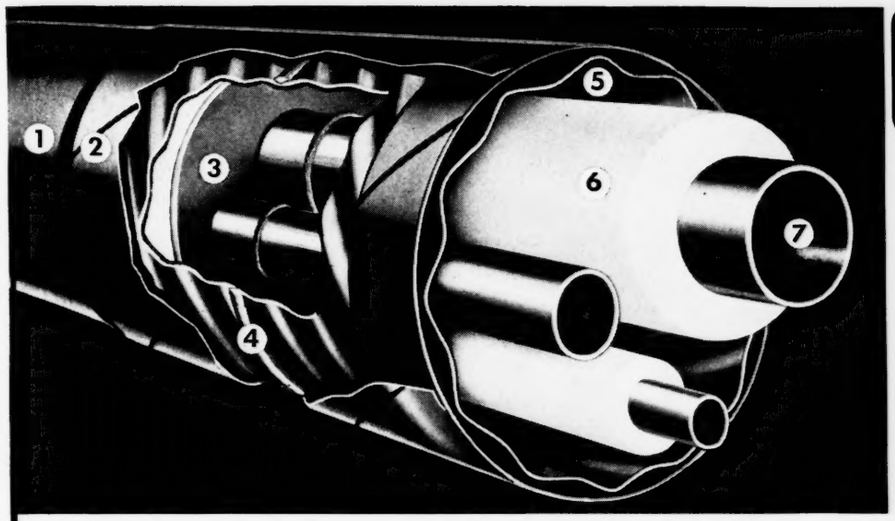
Jas. P. Marsh Corp., Chicago, has appointed *Douglas McClure Lyon*, 317 State Tower Building, Syracuse, as representative in that territory.

Carrier Corp., Syracuse, N. Y., has elected *Cloud Wampler*, Chicago, as executive vice-president. Mr. Wampler, who is president of Stern, Wampler & Co., Inc., investment banking firm, has been associated with Carrier Corporation since 1932. He has been a member of the company's board of directors for the past eight years and served on the executive committee from 1935 to its discontinuance in 1938. For the past several years he has been chairman of the finance committee, which position he will continue to hold.

W. A. Russell and Company, Bridgeport, Conn., has appointed *S. W. Mears* as sales and development engineer. He will devote his time to the new *Warco Moisturator*.

The Auer Register Company, Cleveland, Ohio, has appointed *Herbert J. Curtis* as sales manager. Mr. Curtis has a background of considerable experience in heating lines and is well and favorably known to the trade.

Airtemp Div., Chrysler Corp., Dayton, Ohio, has appointed *J. E. Hoyt*, special assistant to the president, to the post of regional sales supervisor. He will make his headquarters in Dayton.



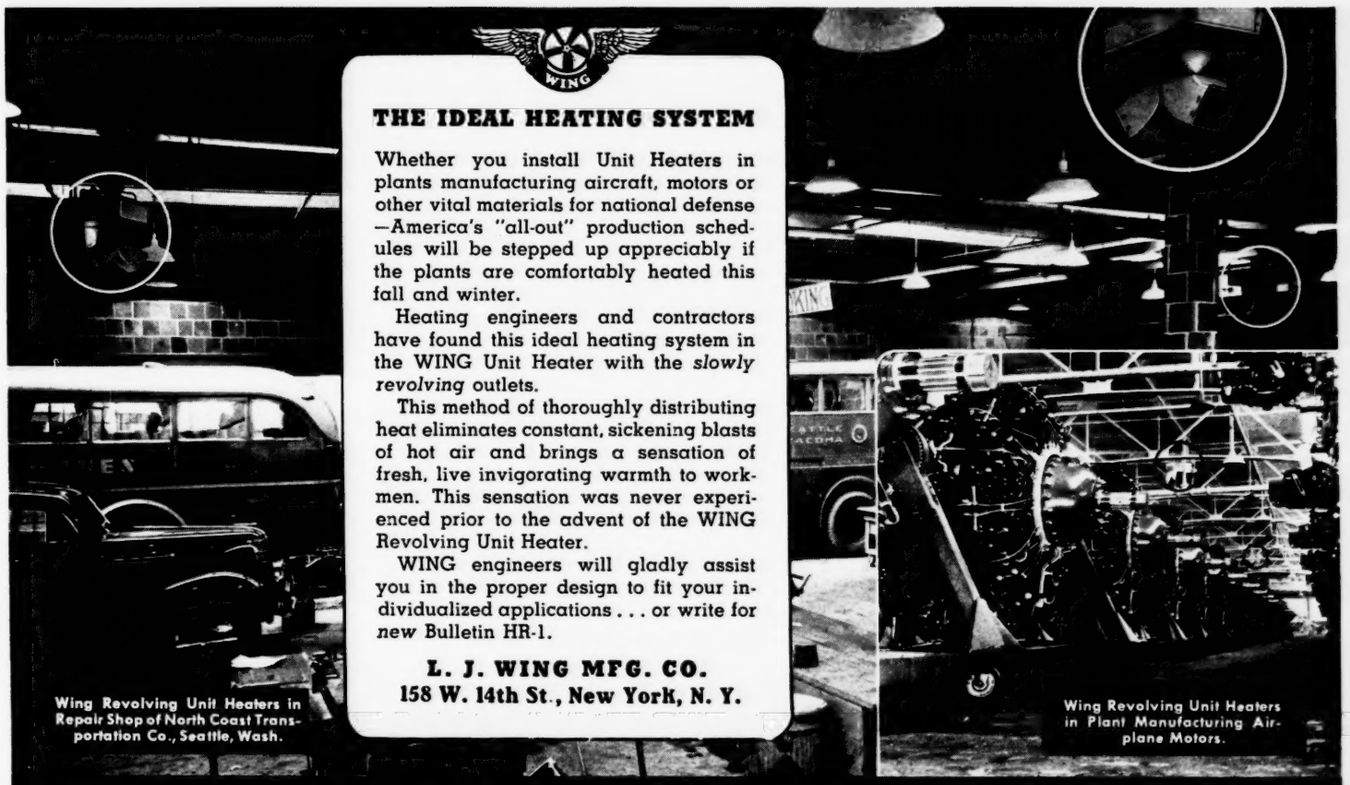
RIC-WIL

1. ASBESTOS FELT OVER ASPHALT COATED HEL-COR
2. THICK STRIP ASPHALT APPLIED AFTER WELDING
3. PIPE SUPPORT
4. BUTT WELDED CONNECTION
5. AIR SPACE
6. SECTIONAL PIPE COVERING
7. STEAM PIPE

PRE-SEALED INSULATED PIPE UNITS

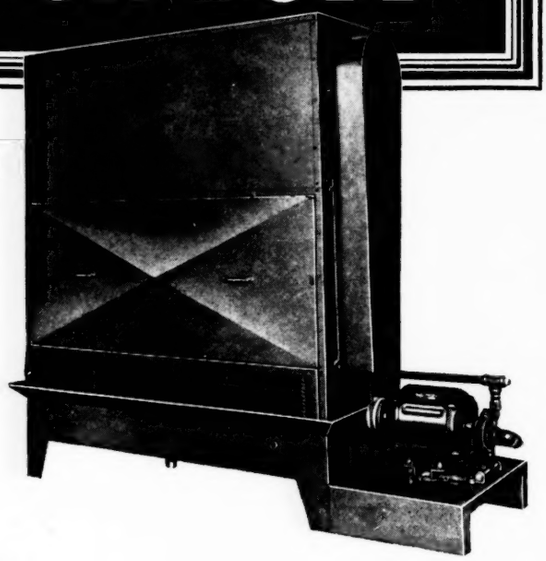
● The factory pre-fabricated system, completely engineered for modern demands on underground distribution of steam, hot water, and oil ● High thermal efficiency, long life, low installation cost ● Each unit shipped complete as shown, in 20-ft. units, or as required ● All fittings and accessories included ● Units are joined by split coupling or by welding ● Insulation can be any type specified by you ● Prompt shipment—speedy installation—nothing else to buy ● Bulletin on request.

THE RIC-WIL COMPANY CLEVELAND, OHIO
Agents in Principal Cities


WING
THE IDEAL HEATING SYSTEM
Whether you install Unit Heaters in plants manufacturing aircraft, motors or other vital materials for national defense—America's "all-out" production schedules will be stepped up appreciably if the plants are comfortably heated this fall and winter.
Heating engineers and contractors have found this ideal heating system in the WING Unit Heater with the *slowly revolving* outlets.
This method of thoroughly distributing heat eliminates constant, sickening blasts of hot air and brings a sensation of fresh, live invigorating warmth to workmen. This sensation was never experienced prior to the advent of the WING Revolving Unit Heater.
WING engineers will gladly assist you in the proper design to fit your individualized applications . . . or write for *new* Bulletin HR-1.
L. J. WING MFG. CO.
158 W. 14th St., New York, N. Y.
Wing Revolving Unit Heaters in Repair Shop of North Coast Transportation Co., Seattle, Wash.
Wing Revolving Unit Heaters in Plant Manufacturing Airplane Motors.

WING REVOLVING DISCHARGE UNIT HEATERS

MARLO PRODUCTS ON DUTY



Marlo Products are on duty in Aircraft, TNT, Small Arms Ordnance, Bomber Assembly, Aircraft Engine Plants, Army Cantonments, Hospitals, Research and Experimental Laboratories.

BUY MARLO EQUIPMENT WITH CONFIDENCE

Fin Coils — **Unit Product Coolers**
Evaporative Condensers — **Brine Spray L.T. Units**
Industrial Coolers — **Air Conditioning Units**
Low Temperature Electrical Defrosting Units

Write for Bulletins

MARLO COIL COMPANY

6135 Manchester Ave., St. Louis, Mo.

★ ★ ★

NEW TRADE LITERATURE

Boilers. A series of twelve direct mailing cards issued by Spencer Heaters as their part of the "War on Waste" campaign. These cards written in the trade vernacular and illustrated with amusing cartoons, deal with the problems encountered day in and day out by heating contractors and engineers. Cards are designed to be mailed to architects, property management groups, builders, and similar persons to educate them on the need for installing a good heating system. SPENCER HEATER DIVISION, AVIATION MANUFACTURING CORPORATION, WILLIAMSPORT, PA.

Dehumidifiers. A standard size three color, 12-page bulletin No. 101 illustrating and describing the part which Lectrodryers are playing in the National Defense program. Includes a number of photographs showing actual installations of Lectrodryer equipment in industry. PITTSBURGH LECTRODRYER CORPORATION, P. O. BOX 1766, PITTSBURGH, PA.

Reciprocating Compressors. Two standard size loose-leaf bulletins on Trane reciprocating compressors. The first bulletin DS-361 has 16 pages and describes the Trane line of reciprocating compressors which are available in sizes from 3 to 50 tons. The second bulletin S-399 has 24 pages and is devoted to the description of Trane turbo-vacuum compressors which are designed to supply chilled water for air conditioning and industrial process work. These units are available in 50 to 200 ton models. Both catalogs include complete information on construction features, capacities, dimensions and specifications. THE TRANE COMPANY, LA CROSSE, WIS.

Refrigeration. A standard size 72-page catalog No. R-142 illustrating and describing the company's line of Kramer Refrigeration equipment. Gives information on baffles, bare tube coils, condensers, heat interchangers, ice makers, unit coolers, and water coolers. Also includes 12-page engineering section which should be of considerable help to refrigeration estimators. KRAMER TRENTON COMPANY, TRENTON, N. J.

Air Conditioning. Standard size 12-page loose leaf bulletin DS-362, on the Trane line of self-contained air conditioning units Gives information on the features of construction, specifications, and dimensions of these air conditioning units which are available in sizes from 3 to 15 tons cooling capacity. THE TRANE COMPANY, LA CROSSE, WIS.

Bearings. A standard size 24-page revised catalog on Selflube porous bearings. Catalog describes the properties and uses of these bearings and furnishes complete details on the correct method of installation. KEYSTONE CARBON COMPANY, SAINT MARYS, PA.

Steam Heating Valves. Standard size bulletin No. 111 describing the Gorton equalizing valves and air eliminators which are designed to act as quick venting valves upon steam heating systems. This company has also issued a 4-page net trade price sheet effective August 11, 1941 which gives the net trade price on Gorton valves. GORTON HEATING CORP., CRANFORD, N. J.

Controls. Standard size, 104-page illustrated catalog No. 41, of the Bonney line of alloy steel wrenches and tools. Gives information on and illustrates the complete line of Bonney tools. BONNEY FORGE & TOOL WORKS, ALLENTOWN, PA.

Heating Specialties. Standard size, 36-page bulletin No. S-260 on the Trane line of heating specialties for steam, vapor, and vacuum heating equipment. Gives information on traps, hermetic valves, bellows valves, strainers, compound gauges, damper regulators, and vent valves. Also contains information on the manufacture of Trane bellows, how the Trane vapor system operates, and includes engineering data for the design of vapor and vacuum heating systems. THE TRANE COMPANY, LA CROSSE, WIS.

Insulation. A 4-page, standard size, two color bulletin illustrating and describing the Unibestos line of insulating blocks, sheets, and sectional pipe covering. This line of insulation is available for temperatures of 750F or 1250F or for intermediate temperatures. Of special interest is a table which gives all of the data needed for figuring the average insulating jobs. UNION ASBESTOS AND RUBBER CO., 1821 So. 54TH AVENUE, CICERO, ILL.

Cooling Coils. Standard size, 68-page bulletin DS-365, on the Trane cooling coils. Includes information on Trane direct expansion cooling coils and gives data on the method of selection, dimensions, capacities, and performance of these coils. Also includes information on advantages and piping details and a considerable amount of engineering data useful in coil selection. THE TRANE COMPANY, LA CROSSE, WIS.

Pumps. A standard size 12-page bulletin No. 78 describing Pacific Single Stage Process Centrifugal Pumps, type SV. These pumps are designed for speeds up to 3600 rpm and are built with capacities from 25 to 1600 gpm with differential pressures up to 300 lb, and temperatures up to 800F. Literature gives information on features of construction and sizes and capacities. PACIFIC PUMP WORKS, HUNTINGTON PARK, CALIF.

Convection. A standard size, illustrated 24-page catalog No. 1975, on the Link-Belt Bulk-Flo power-operated conveyor system for the positive and continuous conveying of flowable granular, crushed, ground, or pulverized materials in capacities of 1 to 140 tons per hour. LINK-BELT COMPANY, 307 NORTH MICHIGAN AVENUE, CHICAGO, ILL.

Valve Packings. A standard size, 24-page illustrated catalog, PK-12A, containing service recommendations and suggestions for packings and gaskets. In addition to detailed information on J-M packing and gasket styles, the handbook includes recommendation tables which serve as a guide to proper packing selection for various types of equipment under such diversified service conditions as steam, brine, ammonia, acids, caustics, and oils. JOHNS-MANVILLE, 22 EAST 40TH ST., NEW YORK, N. Y.

Underground Conduit. A standard size 24-page catalog No. 41 containing complete data on all approved types of construction on underground conduit systems for steam and hot water lines with special emphasis on Ric-wiL Pre-Sealed Insulated Pipe Units. THE RIC-WIL COMPANY, CLEVELAND, OHIO.

Air Conditioning. A two-page bulletin C-1100-S23A illustrating and describing the Worthington Carbondale combined unit air conditioners, PC series. Gives information on the sizes and capacities as well as construction features. CARBONDALE DIVISION, WORTHINGTON PUMP AND MACHINERY CORPORATION, HARRISON, N. J.

Will Your Specifications Call for LAZY AIR or AGITAIR?

Take a Tip From Ford:

Active air means active men. That's why designers of defense projects like the new Ford Magnesium Foundry specify AGITAIR Type "R"—the only diffuser that provides complete control of air distribution.

MORE and more plants are turning to AGITAIR Type "R" for ideal air distribution. It insures worker comfort and efficiency because it assures a continuous flow of fresh, invigorating, active air. No drafts . . . no stale air . . . no hot and cold spots.

HERE'S THE SECRET OF AGITAIR—

Greater Turbulence in the Primary Air Stream . . . from 64 independent air streams per sq. ft. That's why you get correct air distribution with AGITAIR. That's why we say—64 air streams are better than 1.

THE ONLY COMPLETE LINE OF AIR DIFFUSERS FOR BOTH CEILING AND SIDEWALL DISTRIBUTION.

A SHAPE, SIZE, TYPE, AND MODEL FOR EVERY INTERIOR

Write for Information

O MEMO O

WHEN YOU SPECIFY AIR DIFFUSERS — REMEMBER THESE

AGITAIR ADVANTAGES

- √ Easily dampered with directional louvres.
- √ Simpler to install—lighter. Smaller overall dimensions.
- √ Greater diffusing ability—greater turbulence from 64 independent air streams per sq. ft.
- √ Diffusion pattern control in sizes from 6" x 6" to 9' x 9'.
- √ Square or rectangular to match the straight lines of plant design.

AGITAIR
TEMPERATURE EQUALIZER
AIR DEVICES, Inc.
17 East 42nd St., New York, N. Y.
Specialists in Air Distribution and Control
Representatives in principal Cities

Air Devices Inc.
17 East 42 St., New York, N. Y.
Gentlemen: Please send me Catalog "R". Also complete information on "Diffusion Pattern Control".
Name _____
Address _____

Pumps. A 12-page standard size catalog W-483-B1, illustrating and describing the Worthington Rotary pumps with double-helical gears. Among pumps described are the types G1 for small capacity, low pressure service; type GR for handling liquids having lubricating value; type GRJ for handling liquids which solidify and flow when heated; type GRV for shipboard service; type GEC for cargo unloading; type GES for handling non-abrasive viscous chemicals, and type GE for handling corrosive or slightly abrasive liquids. Worthington Pump and Machinery Corporation, Harrison, N. J.

Controls. 1941 issue of the Twin Contact Controls Handbook which includes control and installation material for oil, stoker or gas fired automatic heating systems, each published in a separate handbook or bound in any combination of the three. Each book has three main sections: (1) the catalog section, (2) the wiring diagram section and (3) the engineering and service section. Perfex Corporation, 500 W. Oklahoma Ave., Milwaukee, Wis.

Welding. A 16-page booklet on bronze welding. Gives data on the type of bronze welding alloys available together with descriptions of physical properties and applications. Bridgeport Brass Company, Bridgeport, Conn.

Hot Water Heating. A four-page standard size bulletin G-641 on Thrush forced circulating systems for gas fired hot water boilers. Bulletin contains three diagrams showing how Thrush equipment is used with gas boilers; also includes brief descriptions of the various items of Thrush equipment for use on this type of system. H. A. Thrush & Co., Peru, Indiana.

Radiator Heating. Three standard size bulletins on radiator heating with particular emphasis on Burnham Boiler heating equipment. First bulletin is entitled "Burnham Home Heating Helps Told in a Friendly Way," and gives information for the home owner on Burnham boilers, radiators, air conditioning units, and attic fan coolers. Also gives information for the home owner on how to select a heating system. The second bulletin entitled "Hank Sez," lists 29 arguments in favor of radiator heating. The third bulletin entitled "Putting Smiles in Your Heating and Comfort in Your Living," is devoted primarily to pointing out how Burnham radiators can be attractively fitted into modern rooms. Burnham Boiler Corporation, Irvington, N. Y.

Air Conditioning. A standard size, 16 page catalog illustrating and describing Carrier air conditioning, refrigeration, and heating equipment. Gives brief description, specifications and data on the various items of Carrier equipment available for industrial uses. Carrier Corporation, South Geddes Street, Syracuse, N. Y.

Stove Pipe. The complete line of Follansbee Forge stove pipe, furnace pipe and fittings is described in this new 12-page, standard-size catalog. Gauges, sizes and shipping weights are listed, and alternative methods of closing and locking the pipe are illustrated. Sheet Metal Specialty Company, Third and Liberty Avenues, Pittsburgh, Pa.

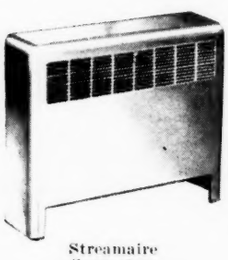
Drafting Machine. A 4-page, standard size bulletin describing the company's recently developed low priced drafting machines. The Drafto Company, 159 Walnut St., Cochranton, Pa.

YOUNG

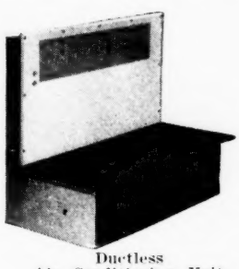
High Efficiency STREAMAIRE

AIR CONDITIONING UNITS

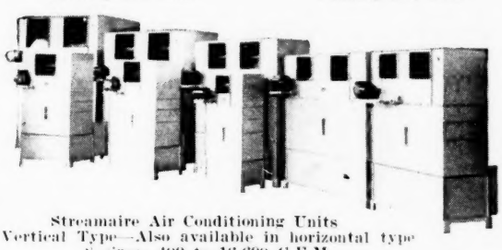
What's your heating or air conditioning problem? Does it call for dependable equipment that will deliver stand-out performance . . . year in and year out . . . at low operating cost? Then look to this latest complete line of Young High Efficiency units. Built with the latest engineering advancements these sturdy, compact units come in a wide selection of types, sizes, and capacities . . . for homes, offices, stores, public and industrial buildings . . . for a single room or building of any size . . . for summer comfort, for heating only, or for year 'round use. Call in a Young representative. He'll gladly cooperate with you—help you work out a sound, practical solution to any air conditioning problem.



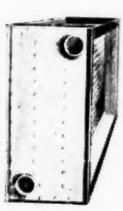
Streamaire Convectors Catalog No. 4039



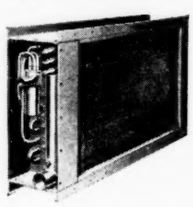
Ductless Air Conditioning Unit Catalog No. 7040



Streamaire Air Conditioning Units Vertical Type—Also available in horizontal type 8 sizes—400 to 16,600 C.F.M. Catalog No. 7541



Water Cooling Coil Cleanable Tube—Type "K" Catalog No. 5537



Evaporator Coil Catalog No. 5039

Water Cooling Coil U-Bend—Type "W" Catalog No. 5537

Young High Efficiency HEATING COOLING AND AIR CONDITIONING UNITS

UNIT HEATERS • CONVECTORS • CONDENSERS • EVAPORATORS • AIR CONDITIONING UNITS • HEATING COILS • COOLING UNITS

Young Quality

OIL COOLERS • GAS, GASOLINE DIESEL ENGINE COOLING RADIATORS • INTERCOOLERS • HEAT EXCHANGERS • ENGINE JACKET WATER COOLERS

REG. U.S. PAT. OFF.

Offices in All Principal Cities

YOUNG RADIATOR CO., Dept. 101-H, Racine, Wisconsin, U. S. A.

Smoke Control. A standard size, 4-page bulletin No. 542, illustrating and describing the Rehtron photo-electric smoke indication and combustion control. Bulletin describes the indicator signal type which continuously indicates smoke density in breeching or stack and provides for an immediate bell or light signal when smoke exceeds maximum allowable density. Also describes the automtic control model which provides all of the features of the model described above, as well as gives full automatic control for magnetic solenoid valve or blower motor. REHTRON CORPORATION, 2159 MAGNOLIA AVE., CHICAGO, ILL.

Radiators. Standard size 4-page folder No. 525, on the Burnham slenderized radiator. Gives information on the ratings and dimensions and sales features of these radiators. BURNHAM BOILER CORPORATION, IRVINGTON, N. J.

Piping. The first of a series of folders designed to help the users of pipe materials to get the maximum out of their equipment. These folders will be released at intervals and each one will show, in a simple graphic form, many ideas pertaining to piping assembly. This pamphlet is entitled, "How to Keep Your Plant Going Without Interruptions," and shows 14 practical kinks on pipe. CRANE COMPANY, 836 S. MICHIGAN AVENUE, CHICAGO, ILL.

H&V'S PHOTOS

Page 23-25—*Heating, Cooling & Piping.* Toronto, Can.
Pages 26, 27—The Austin Company, Cleveland, Ohio.
Pages 30-33—Cosmo-Sileo, New York, N. Y.
Page 44—Harris & Ewing, New York, N. Y.

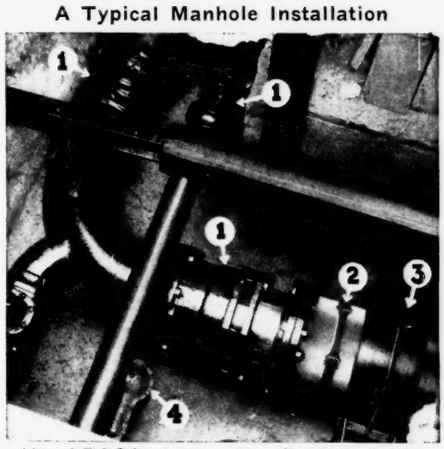
SUMMER DEGREE HOURS (Above 85F) APRIL AND MAY, 1941

City	Number of Degree-Hours April, 1941	Number of Degree-Hours May, 1941	Number of Degree-Hours, Summer, 1941, to May 31
Baltimore	78	400	478
Birmingham	0	336	336
Bismarck	0	123	123
Boston	6	62	68
Chicago	0	60	60
Cincinnati	1	209	210
Cleveland	0	23	23
Columbus	2	209	211
Des Moines	0	64	64
Detroit	0	69	69
Fort Wayne	0	71	71
Grand Rapids	0	11	11
Houston	0	146	146
Indianapolis	0	226	226
Memphis	0	305	305
Milwaukee	0	16	16
Minneapolis	0	21	21
New Orleans	0	190	190
New York	0	17	17
Oklahoma City	0	49	49
Philadelphia	41	157	198
Pittsburgh	0	36	36
Portland, Ore.	0	21	21
Richmond, Va.	107	446	553
Rochester	0	23	23
St. Louis	10	190	200
San Francisco	0	3	3
Savannah	28	363	391
Syracuse	11	27	38
Toledo	0	96	96
Washington	94	361	455

ADSCO INTERNALLY GUIDED JOINT

A COMPACT, EASILY INSTALLED JOINT FOR HIGH OR LOW PRESSURES

A Typical Manhole Installation



(1) ADSCO Internally Guided Joints in manhole under construction (2) ADSCO Insulation Support (3) ADSCO Pipe Alignment Guide and (4) ADSCO Empire Steam Trap.

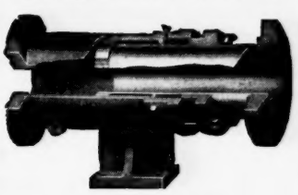
Can be specified with Confidence for years of Efficient Operation —Hundreds in Daily Use

An internal guide on the inner end of the slip provides true axial movement throughout entire slip traverse. No metal to metal contact between polished slip surface and body. Slip cannot pull out of the joint. A compact joint for restricted space — largest diameter is the flange.

Available in single or double joints in semi-steel or steel bodies for high pressures and high temperatures with flanged or beveled ends.

Write for Bulletin No. 35-30V

Sectional View of Joint



A Few Users

Cons. Gas, Elec. Lt. & Pr. Co. Baltimore, Md.
Philadelphia Electric Co. Philadelphia, Pa.
Atlanta University Atlanta, Ga.
Moose Lake State Hospital Moose Lake, Minn.
Olds Motor Works Lansing, Mich.
Union Pacific R. R. Co. Council Bluffs, Ia.
U. S. Navy Yard Brooklyn, N. Y.
Wards Island Sewage Works Wards Island, N. Y.

AMERICAN DISTRICT STEAM COMPANY

NORTH TONAWANDA, N.Y.
IN BUSINESS OVER SIXTY YEARS

YARWAY GUN-PAKT EXPANSION JOINT

It is packed under full steam pressure. By the turn of a wrench, integral pressure guns force a special semi-plastic packing into the stuffing box.

Welded Steel Construction. Alemite lubricated cylinder-guided sleeve. Made also in conventional gland-pakt types. Write for Bulletin EJ-1907.

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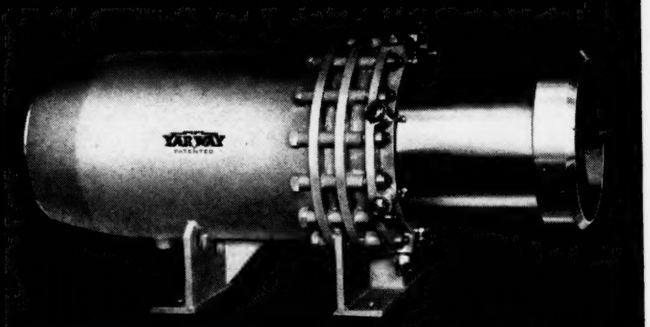
YARNALL-WARING COMPANY
104 Mermaid Ave. PHILADELPHIA

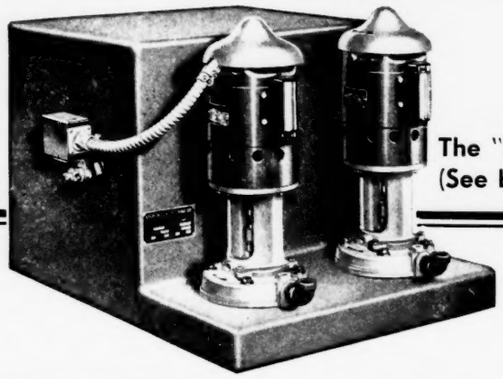


LOW COST Gas Unit Heating

REZNOR Unit Heaters provide installation and operating flexibility. Due to special heat exchanger tubes, more heat is moved economically over larger areas. Gas for fuel permits easier and lower cost installation, and intermittent firing reduces fuel expense. Thousands of Reznor Units are operating dependably in some of America's largest factories and commercial buildings. There's a size and type for every need. Write for useful catalog U 41 today.

REZNOR MANUFACTURING CO.
302 James St. MERCER, PA.

REZNOR
"GAS HEATERS EXCLUSIVELY SINCE 1888"



The "3900" (See below)

Meets ALL Capacity Needs!

STERLING line of CONDENSATION PUMPS

- THE 4000 "LOWBOY" 1000 to 3000 sq. ft. EDR (Above ground or underground)
- THE 3900 SERIES 6000 to 40,000 sq. ft. EDR
- THE 3800 SERIES 1000 to 10,000 sq. ft. EDR
- THE 3700 SERIES 2000 to 20,000 sq. ft. EDR (underground)
- THE 3500 SERIES 2000 to 65,000 sq. ft. EDR

★ WRITE FOR CATALOG 340-D ★

STERLING, INC.

3732 N. HOLTON ST. • MILWAUKEE, WISCONSIN

WE ARE BUSY

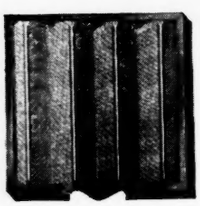
We are doing our part in the National Defense Program

BUT—WE ARE NOT TOO BUSY to take care of our regular clientele.

Place Orders as Early as Possible

Shell and Tube Condensers—Evaporative Condensers—Shell and Tube Water Coolers—Storage Water Coolers—Pipe Coils—Cooling Units—Heat Exchangers

Jackson **ACME INDUSTRIES** Michigan



Make the first cost the last cost!

SOMERS HAIR GLASS FILTER

Where Somers Hair Spun Glass Filters are installed as original or replacement equipment there's an end to the cost. Somers Filters are washable, odorless, non-absorptive, do not rot, and are practically indestructible.

Dust, dirt, pollen and detritus in the air stream effectively removed with minimum back pressure. No adhesives required.

Somers Filters may be cleaned easily by using the stream from an ordinary water hose (at city pressures) pinched to obtain a spray effect.

For complete details and prices, write giving the c.f.m. per unit and dimensions of present master holding frame. A few choice territories are available for representatives. Full particulars on application.

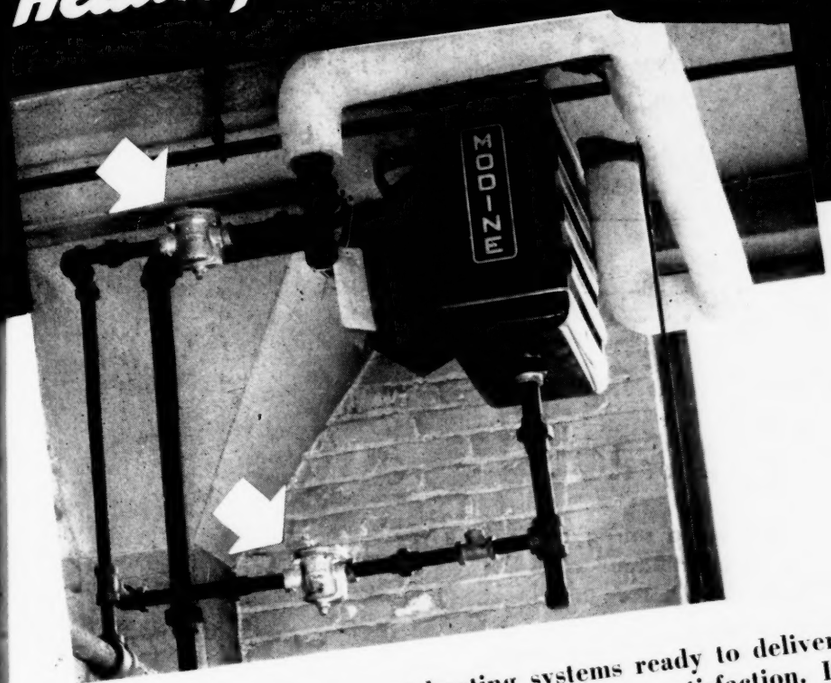
H. J. SOMERS, INC., 6065 WABASH AVE., DETROIT, MICH.

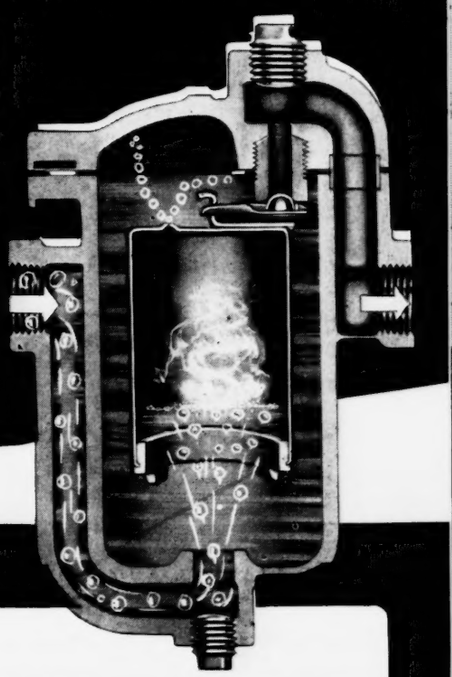
HEATING AND VENTILATING

The Air Conditioning Monthly

POPULAR for Low Pressure Heating Service

ARMSTRONG "Side Inlet" STEAM TRAPS

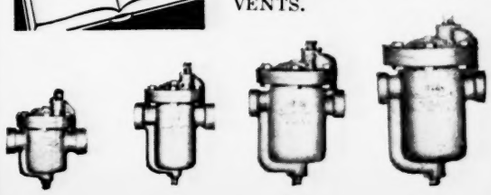




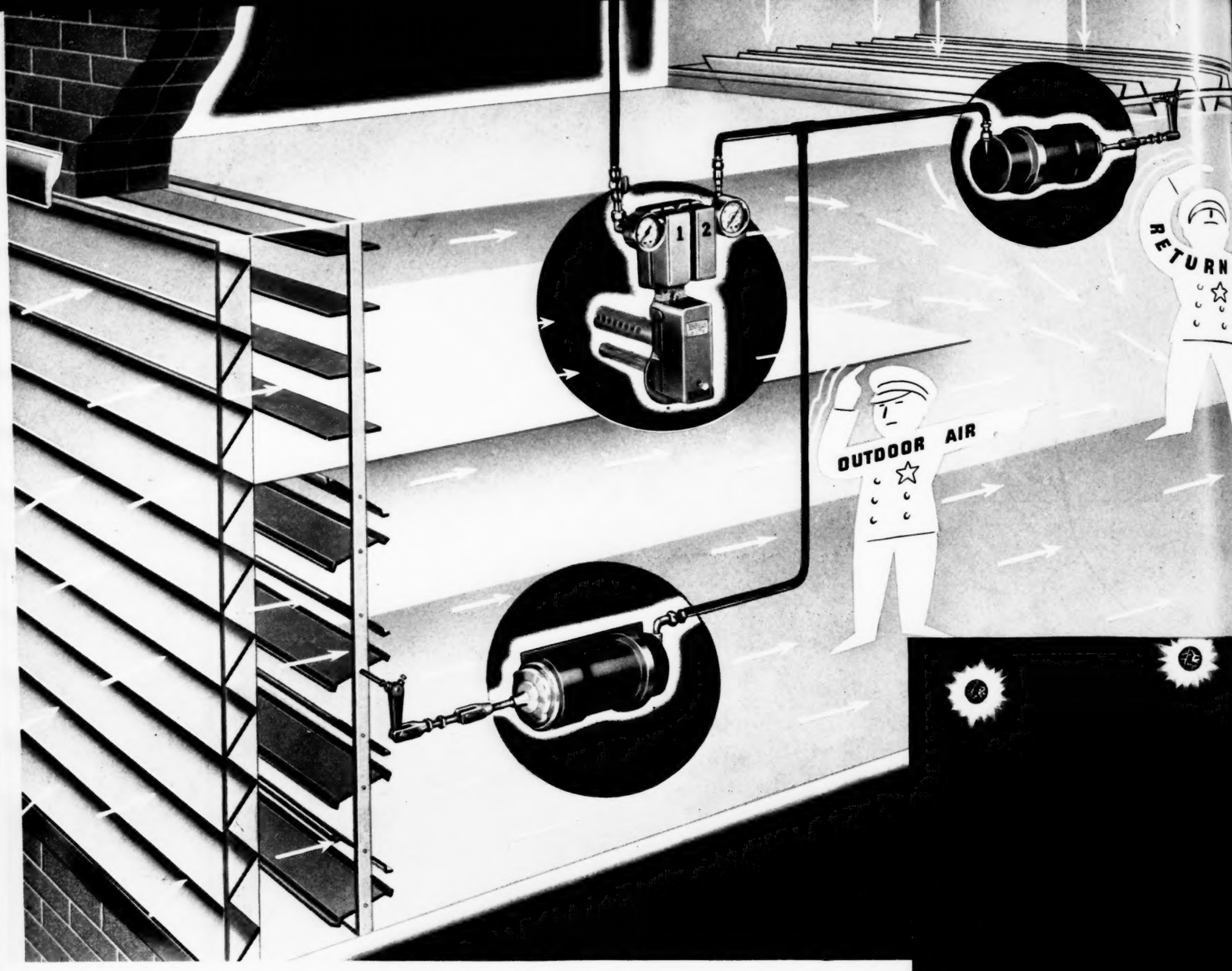
NOW is the time to get heating systems ready to deliver a full season of uninterrupted heating satisfaction. If you are getting tired of paying frequent bills for a constant string of repair parts on ordinary low pressure traps, do like hundreds of others are doing: Change over to new style Armstrong traps. They cost very little more and they have the high quality operating mechanism that has been used with such outstanding success in Armstrong traps for high pressure service. Numerous users report handsome savings of annual trap costs in addition to enjoying a standard of heating service beyond any previous expectation. Traps carried in stock at 140 points. For catalog, write ARMSTRONG MACHINE WORKS, 846 Maple Street, Three Rivers, Michigan.

ADVANTAGES OFFERED

THESE traps feature the basic body design which has been used by Armstrong for several years for side inlet traps. Advantages offered by this design: (1) Trap cap, carrying complete mechanism, can be removed without disturbing pipe connections. (2) Leaving the trap body permanently in the line obviates any necessity of ever having to handle a vessel filled with hot condensate or having to reprime the trap after such occasions. (3) Unexcelled installation convenience where it is practical to use horizontal, straight-through pipe connections. WHERE "BLAST" TYPE TRAPS ARE DESIRED, THESE TRAPS CAN BE SUPPLIED WITH THERMIC BUCKET VENTS.



800 811 812 813



REDUCED LOAD — MAXIMUM ECONOMY

Under Varying Outdoor Atmospheric Conditions

with JOHNSON *Comfostat* CONTROL

Here's the answer to the problem of how to determine the proper quantity of outdoor air to bring into an air conditioning system, under all conditions! The special Johnson "Comfostat" automatically produces the most desirable cycle of operation, allows outdoor air or return air—or a mixture of both—to enter the system, whichever is most economical. In the illustration above, a Johnson "Comfostat", in the minimum outdoor air intake, measures the temperature and relative humidity of the outdoor air. When that combined effect is below the setting which has been adopted for "Point 1" of the "Comfostat", only a minimum quantity of outdoor air is admitted. As the temperature and humidity begins to rise above the setting of "Point 1", the maximum outdoor air damper gradually opens, while the return air damper closes. When the outdoor temperature and humidity have risen sufficiently to exceed the higher setting, ("Point 2" of the "Comfostat"), the maximum outdoor air damper gradually closes while the return air damper opens. For year 'round automatic operation, minimum quantities of outdoor air are used when the weather is cold, maximum outdoor air during the "in-between" seasons, minimum amounts again when the outdoor air is hot and moist. Ask for a complete explanation of this distinctive Johnson control. Send for bulletins.

Engineering Library

Presenting

DIFFUSION PATTERN CONTROL

An Entirely NEW Development in Air Diffusers

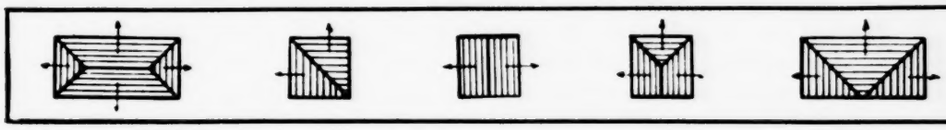
AT last—a diffuser that provides complete control of air distribution—AGITAIR TYPE "R". It requires no baffles, no blank-offs. Its patented construction permits it to be assembled into numerous patterns which will discharge the required portion of the total air in one or more directions . . . thus creating a diffusion pattern which will fit the contour of the area to be ventilated.

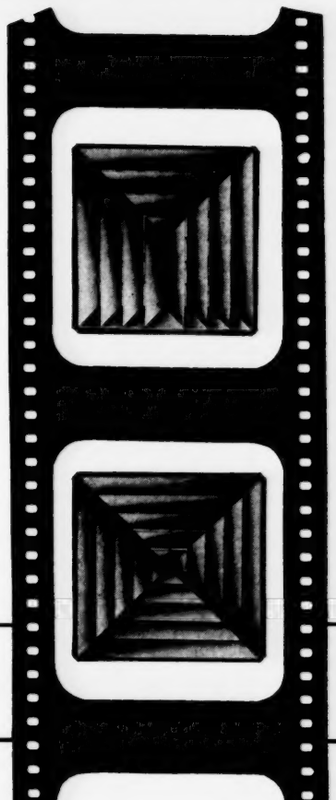
Diffusion Pattern Control is in-built in AGITAIR TYPE "R". No wonder every day, more and more specifications read—

The diffusers shall be constructed to give one, two, three or four way blow with each side delivering a quantity of air proportional to the area it serves. Diffusers shall be AGITAIR TYPE "R" as manufactured by AIR DEVICES, Inc., or equal as approved.

AGITAIR TEMPERATURE EQUALIZER TYPE R

Send for Data Sheets and Informative Booklet on Diffusion Pattern Control.



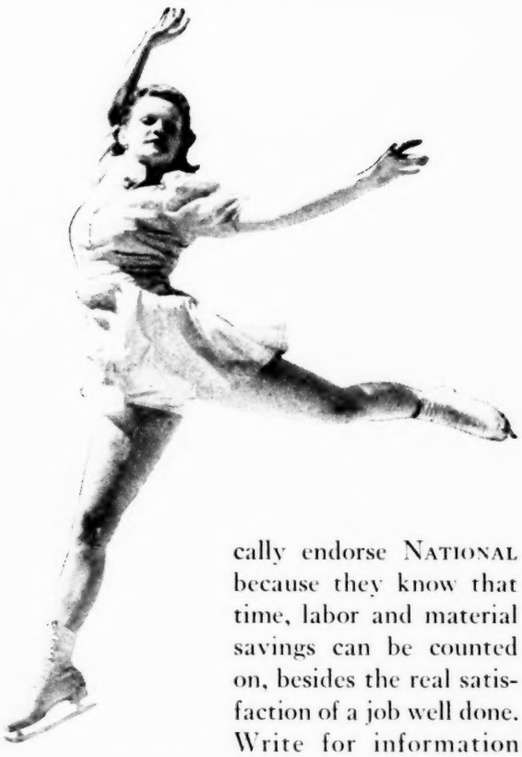


AIR DEVICES, Inc. • MAIN OFFICE: 17 EAST 42nd ST., NEW YORK, N. Y.
REPRESENTATIVES IN 25 PRINCIPAL CITIES

HEATING & VENTILATING, *formerly* HEATING & VENTILATING MAGAZINE, published monthly by THE INDUSTRIAL PRESS, 148 Lafayette Street, New York, N. Y., U. S. A. Subscription rates: United States and Canada, $2.00; Foreign, $3.00. Single copies, 30 cents. Vol. 38, No. 9, September, 1941. Entered as second-class matter, April 18, 1925, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

NATIONAL REFRIGERATION PIPE IS YOUR "BEST BET"

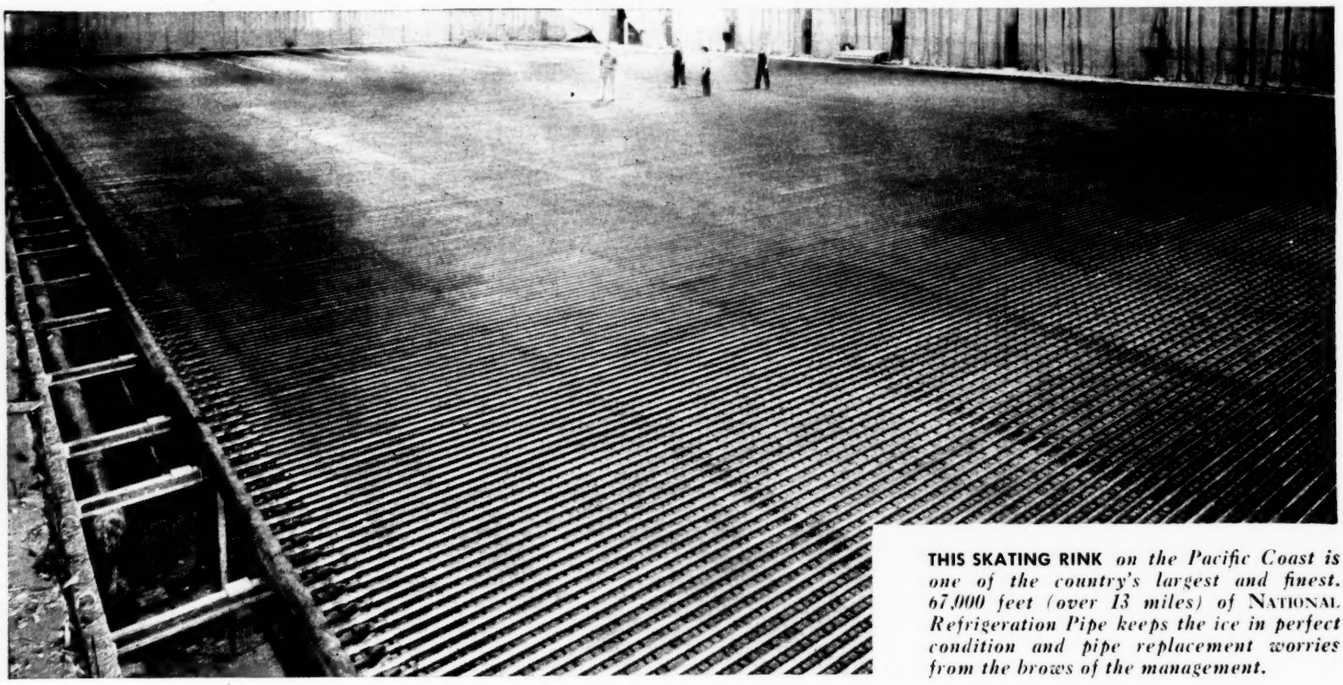
for long life and all-around working qualities



SPECIFICALLY made for just such service, and tested by thousands of installations — NATIONAL Refrigeration Pipe, the first choice among builders of ice and refrigeration equipment, has proved a reliable safeguard against premature replacement.

It resists corrosion and is clean, smooth and uniform. One of its most important advantages is its surprising ductility. In many installations where sharp bends must be made, it is bent regularly around small radii without buckling or splitting. Another advantage is its easy welding and threading qualities. Workmen who have welded or coupled thousands of joints, enthusiastically endorse NATIONAL because they know that time, labor and material savings can be counted on, besides the real satisfaction of a job well done.

Write for information about NATIONAL Refrigeration Pipe. Ask for Bulletin 5. There is a NATIONAL distributor in your vicinity.



THIS SKATING RINK *on the Pacific Coast is one of the country's largest and finest. 67,000 feet (over 13 miles) of* NATIONAL *Refrigeration Pipe keeps the ice in perfect condition and pipe replacement worries from the brows of the management.*

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

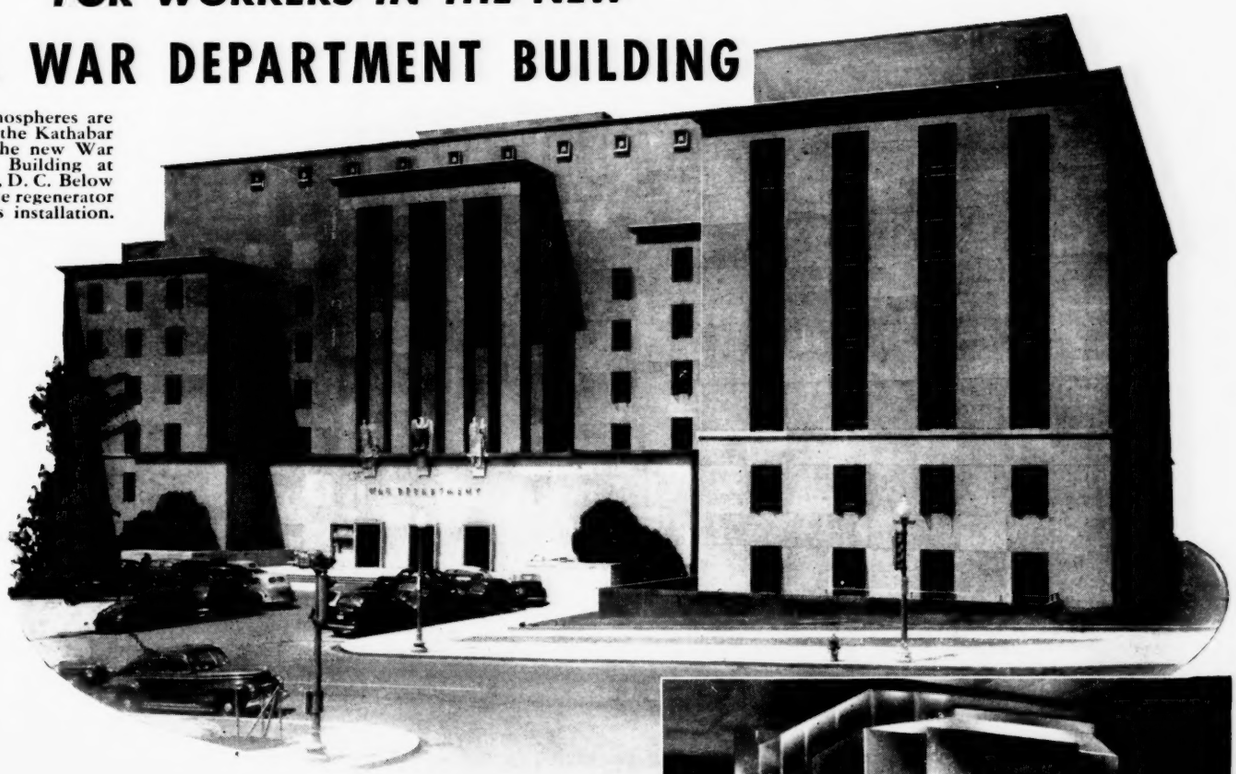
UNITED STATES STEEL

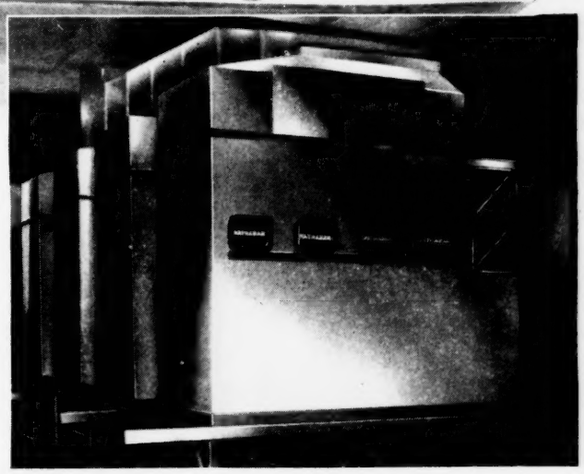
NO CHILL SHOCK CLAMMINESS

FOR WORKERS IN THE NEW

U. S. WAR DEPARTMENT BUILDING

Comfort atmospheres are supplied by the Kathabar System for the new War Department Building at Washington, D. C. Below are shown the regenerator units of this installation.





● *Atmosphere conditions* have a lot to do with the efficiency of indoor workers. That's why *100% comfort atmospheres . . .* now made possible by Kathabar Systems . . . are in such wide demand for commercial and industrial applications to eliminate Chill, Shock and Clamminess.

Kathabar is the system for atmosphere control that successfully solves this problem . . . by *accurately* controlling humidity independent of temperature. This includes both humidifying and dehumidifying as needed.

Humidity is also a factor in industrial processing—and that's another big field served by Kathabar. It's the system that can eliminate the variables of humidity so that you have ideal processing atmospheres for the *entire year.* Whatever your requirements in atmosphere control, investigate *Kathabar for 100% results!*

KATHABAR

SYSTEM OF HUMIDITY CONTROL FOR COMFORT OR PROCESSING ATMOSPHERES!

WHAT IS KATHABAR?

Kathabar is a unit for *completely* controlling humidity in ANY air conditioning system . . . the equipment that dehumidifies and humidifies 100% *accurately.* Can be installed in your present system to eliminate *chill, shock* and *clamminess* . . . or as part of any system you are now considering.

SEND FOR FACTS!

SURFACE COMBUSTION CORPORATION, TOLEDO, O.

I'm interested in 100% RESULTS in Atmosphere Control. Without obligation, please send sample specifications and capacities about Kathabar for uses checked:

- ☐ for Comfort Atmospheres in public buildings
- ☐ for Industrial Atmospheres in large manufacturing plants
- ☐ for Processing Atmospheres in manufacturing plants

*Name*_____

*Company*_____

*Address*_____

*City*_____ *State*_____

RIC-WIL

INSULATED PIPE UNITS

FOR UNDERGROUND STEAM LINES

"Pre-Sealed by Ric-wiL"

1—ASBESTOS FELT OVER ASPHALT COATED HEL-COR

2—THICK STRIP ASPHALT APPLIED AFTER WELDING

3—PIPE SUPPORT

4—COUPLER

5—AIR SPACE

6—RIC-WIL DRY-PAC INSULATION

7—ASBESTOS FELT JACKET

8—STEAM PIPE

• **The factory pre-fabricated system, completely engineered for modern demands on underground distribution of steam, hot water, and oil... High thermal efficiency, long life, low installation cost... Each unit shipped complete as shown, in 20-ft. units, or as required... All fittings and accessories included... Units are joined by split coupling or by welding... Insulation can be any type specified by you... Prompt shipment—speedy installation—nothing else to buy... Bulletin on request.**

THE RIC-WIL COMPANY

CLEVELAND, OHIO • AGENTS IN PRINCIPAL CITIES

SYLPHON CONTROLS

Protect Passenger Comfort

In Railroad Stations and Air Conditioned Cars

Pennsylvania Railroad Passenger Station, Newark, N. J.

The Pennsylvania Railroad has used Sylphon Controls in the regulation of both heating and cooling on cars which are part of that "Largest fleet of air conditioned trains in the world." Their use of Sylphon Controls has not been limited to railroad cars — but extended to buildings as well.

In the new Newark, N. J., Passenger Station (illustrated), Sylphon Automatic Radiator Valves regulate steam flow to concealed radiation in waiting room benches and wall grilles.

The *modulating* action of these self-contained, self-operating individual radiator controls, maintains temperature at 70° F. in all parts of the building in spite of widely fluctuating demands due to constant traffic through the building. Overheating is prevented, effecting material fuel savings.

The complete line of modern Sylphon Controls offers the answer to practically any heating, ventilating and air conditioning control problem. Write for Bulletin RH-821.

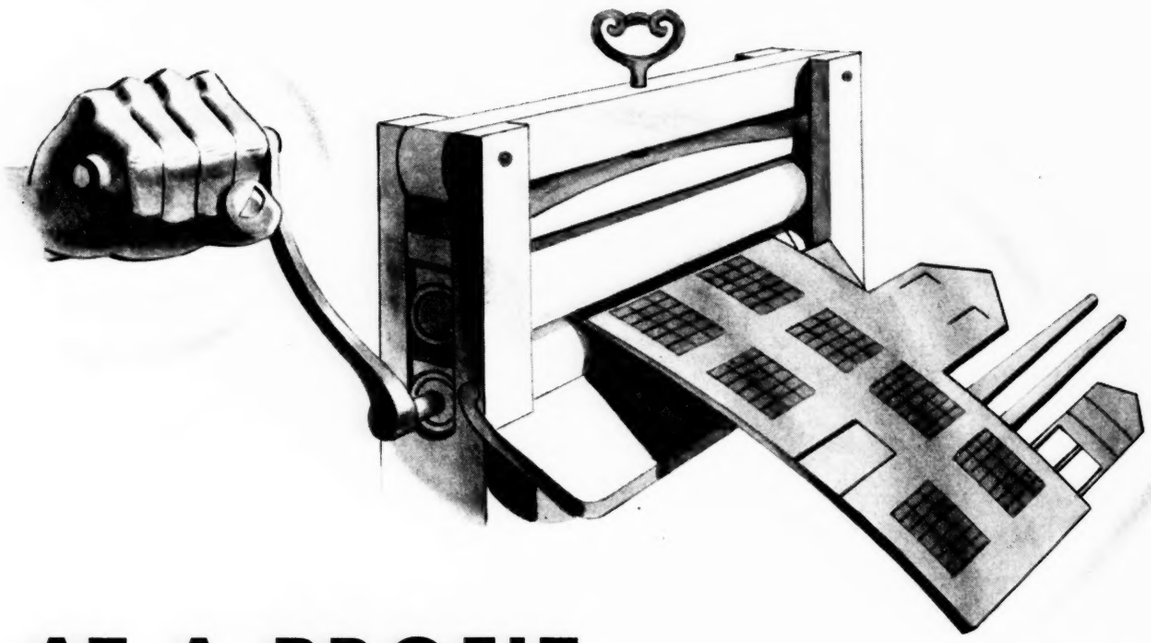
FULTON *Sylphon* TRADE MARK FOR TEMPERATURE CONTROL

THE FULTON SYLPHON CO.

KNOXVILLE, TENNESSEE

Representatives in All Principal Cities in U. S. A. and in Montreal, Canada and London, England

HOW TO PUT A PLANT THROUGH THE WRINGER..



AT A PROFIT

SOLVE HUMIDITY CONTROL PROBLEMS AND STEP UP PRODUCTION WITH BRYANT DEHUMIDIFIERS

Bryant Dehumidifiers remove moisture from the air directly by the solid adsorption method without resorting to low temperature cooling, reheating or by-passing.

Bryant Dehumidifiers facilitate air conditioning system design, operation and service. They may be applied to any system, and provide 100% flexibility of operation and control.

These dehumidifiers are *completely automatic* in operation and may be applied to deliver air at any moisture content down to a virtually bone-dry condition.

Step up your profits by helping your clients step up production with *controlled* humidity.

B-R Dehumidifier—one of five standard models

Bryant Silica Gel Dehumidifiers are a vital part of the air conditioning systems in varied industries.

Here are *just a few* users:

Chrysler Corporation
Eastman Kodak Co.
Eberhard Faber Pencil Co.
Eli Lilly & Co.
Pittsburgh Plate Glass Co.
Southwestern Bell Telephone Co.
Standard Oil Co.
W. B. Coon Co.
Woodward & Tiernan Printing Co.
Wright Aeronautical Corp.

ARCHITECTS, CONTRACTORS, CONSULTING ENGINEERS: Send for Technical and Application Engineering Data.

NAME _____

ADDRESS _____

CITY _____ STATE _____

THE BRYANT HEATER COMPANY
17887 ST. CLAIR AVENUE • CLEVELAND, OHIO

"GOOD VALVE PRACTICE"

For a Meat Packing Plant

(STEAM, WATER AND PROCESS CONNECTIONS)

Jenkins SUGGESTS . . .

Outlook in the meat packing field points to a still further increase in production facilities, improvements in arrangement of departments and the use of mass-production techniques. Although actual installations vary widely in size and complexity of steam, water or process piping requirements, valves must be installed in accordance with accepted good valve practice. In addition, each control point must have a valve designed and constructed to serve efficiently and economically in that specific service. For the diagram below, each control point is keyed to the reference chart where the *basic* valve types are recommended. Then, by offering several Jenkins Figure Numbers, the *specific* valve can be selected by a study of your own requirements.

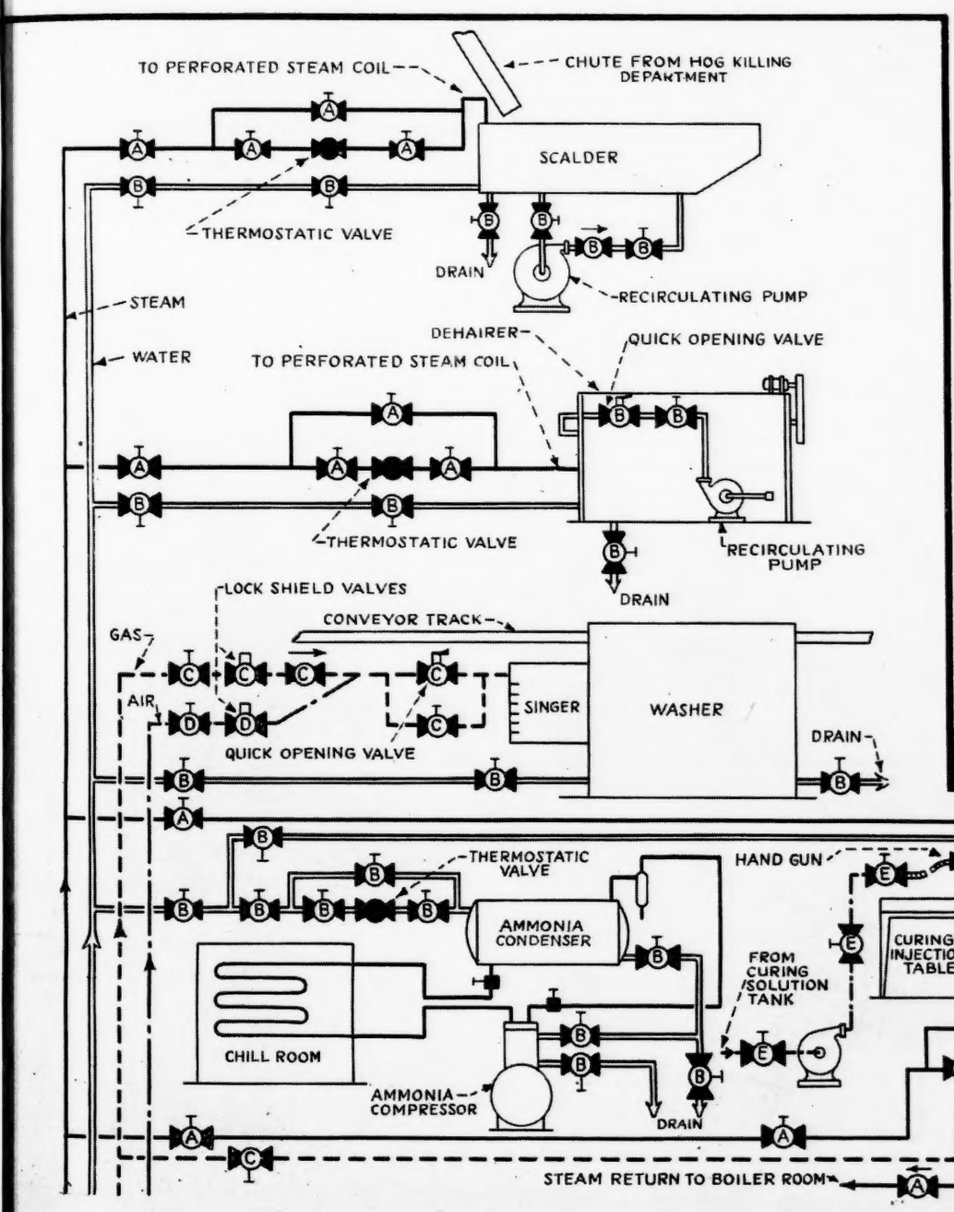


Diagram courtesy of Huxley Madeheim Consulting Engineers

REFERENCE CHART FOR JENKINS FIGURE NUMBERS

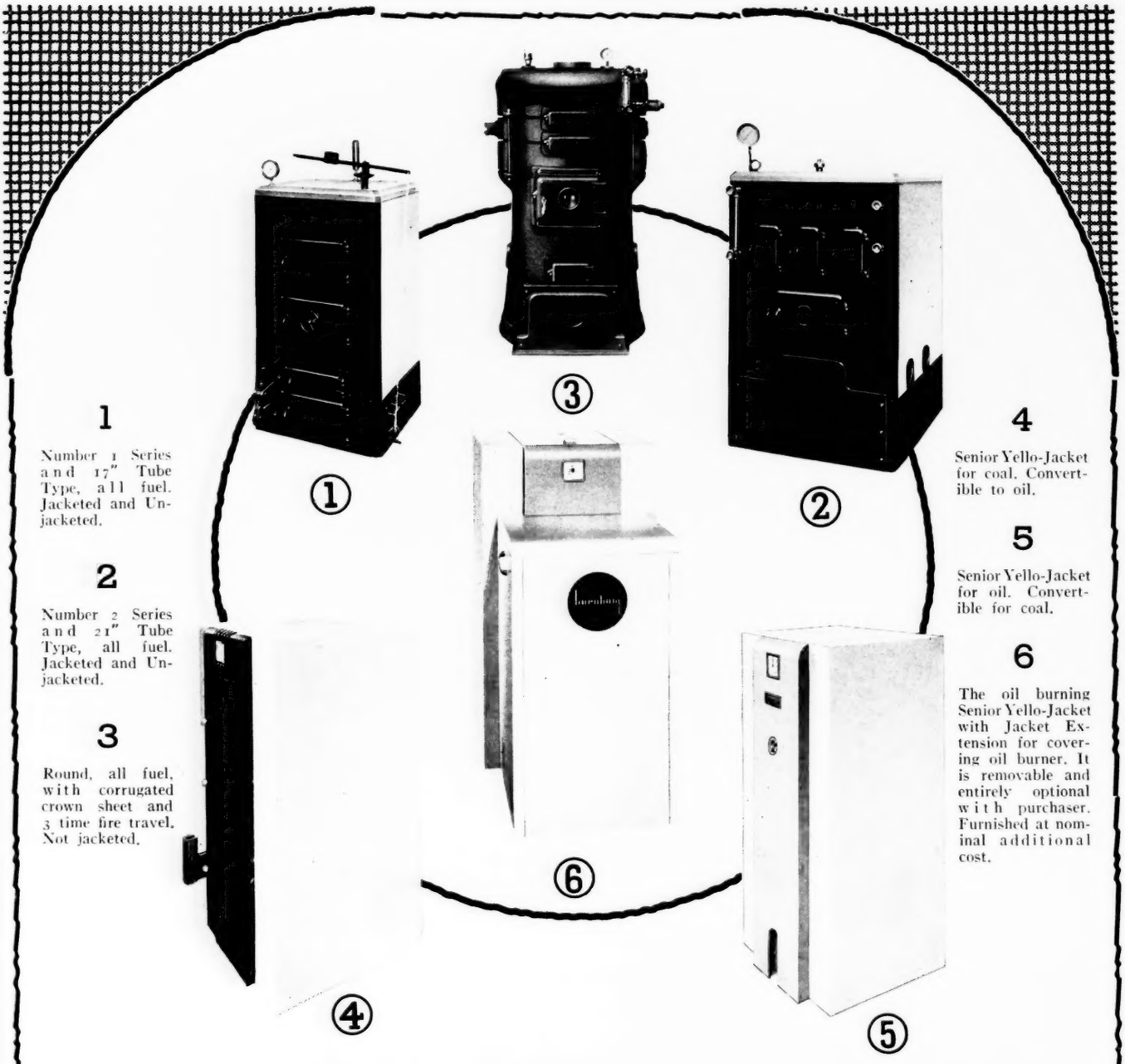
		Standard	Medium	Extra Heavy
A	STEAM LINES GATE	BRONZE 47 Se Travel Spindle 48 Se Travel Spindle 370 Se Non Rising 368 Se O S & Y 628 Se Non Rising 672 Se O S & Y IRON 325 Se Non Rising 326 El Non Rising 630 Se O S & Y 631 El O S & Y	BRONZE 270 Se Non Rising 275 Se O S & Y IRON 251 Se Non Rising 255 El Non Rising 327 Se O S & Y 253 El O S & Y.	BRONZE 280 Se Non Rising 282 Se O S & Y IRON 203A Se Non Rising 205 El Non Rising 203A Se O S & Y 204 El O S & Y.
	SWING CHECK	BRONZE 92 Se Regrinding 352 Se Disc Type 762 Se Regrinding IRON 623 Se Regrinding 624 El Regrinding 294 Se Disc Type 296 El Disc Type	BRONZE 762 Se Regrinding IRON 338 Se Disc Type 339 El Disc Type	BRONZE 962 Se Regrinding 260 Se Disc Type IRON 338 Se Disc Type 339 El Disc Type
	GLOBE	BRONZE 106A Se Disc Type IRON 612 Se Regrinding 613 El Regrinding 141 Se Disc Type 142 El Disc Type	BRONZE 750 Se Regrinding 960 Se Regr Renew 906 Se Regr Renew Plug IRON 918 Se Regrinding 919 El Regrinding 274 Se Disc Type 275 El Disc Type	BRONZE 801 Se Disc Type 1140 Se Regrinding 1140 Se Regr Renew 920 Se Regr Renew 926 Se Regr Renew Plug IRON 922 Se Regrinding 923 El Regrinding 162 Se Disc Type 162 El Disc Type
B	WATER LINES GATE	BRONZE 47 Se Travel Spindle 49 Se Travel Spindle 370 Se Non Rising 368 Se O S & Y 620 Se Non Rising 672 Se O S & Y 674A Se Non Rising 675A El Non Rising 626A Se O S & Y 627A El O S & Y IRON Same as "A" above	BRONZE 270 Se Non Rising 275 Se O S & Y IRON 251 Se Non Rising 255 El Non Rising 327 Se O S & Y 253 El O S & Y	BRONZE 280 Se Non Rising 282 Se O S & Y IRON 203A Se Non Rising 205 El Non Rising 203A Se O S & Y 204 El O S & Y
	SWING CHECK	BRONZE & IRON Same as "A" above	BRONZE & IRON Same as "A" above	BRONZE & IRON Same as "A" above
	QUICK OPENING	BRONZE 712 Se Disc Type 520 Se Disc Type 941 Se Disc Type 526 Se Sliding Spindle IRON 531 Se Sliding Spindle 535 El Sliding Spindle		
C	GAS SUPPLY GLOBE	106A Se Disc Type 1096 Se Disc Type Lock Shield		
	GATE	47 Se Travel Spindle 370 Se Non Rising 318 Se Non Rising Lock Shield		
	SWING CHECK	92 Se Regrinding 352 Se Disc Type		
D	COMPRESSED AIR LINES GLOBE	106A Se Disc Type 169 Se Lock Shield		
	GATE	47 Se Travel Spindle 370 Se Non Rising 318 Se Lock Shield		
E	SOLUTION LINES HAND GUN	699 Se Button Type 610 Se Lever Type 124 Se Lever Type		
	GLOBE	106A Se Disc Type 750 Se Regrinding		

JENKINS BROS., 80 White St., New York, N.Y.; Bridgepo
Conn.; Atlanta, Ga ; Boston, Mass.; Philadelphia, Pa.; Chica
Ill.; Houston, Texas. Jenkins Bros., Ltd., Montreal; London, E

TRADE JENKINS MARK
Jenkins Bros

#8 OF A SERIES designed to help in your selection of JENKINS VALVES

IN VALVES Jenkins GIVES YOU EVERYTHING



1

Number 1 Series and 17" Tube Type, all fuel. Jacketed and Unjacketed.

2

Number 2 Series and 21" Tube Type, all fuel. Jacketed and Unjacketed.

3

Round, all fuel, with corrugated crown sheet and 3 time fire travel. Not jacketed.

4

Senior Yello-Jacket for coal. Convertible to oil.

5

Senior Yello-Jacket for oil. Convertible for coal.

6

The oil burning Senior Yello-Jacket with Jacket Extension for covering oil burner. It is removable and entirely optional with purchaser. Furnished at nominal additional cost.

5 Burnham Conversion Boilers

THE War Emergency is here, and all of us are going to be inconvenienced and pinched. Fuel may be one of the pinchers.

Burnham is gladly doing its bit to help solve the whole fuel question, regardless of what the fuel may be.

We make several special boilers for the exclusive burning of oil and gas. Also 5 conversion boilers *for all fuels*. Ones that can quickly and at comparatively small cost, be shifted from one fuel to the other.

Furthermore, we are making a special low cost offer on equipment for converting oil boilers to coal.

We offer you a liberal 40% extra discount on this conversion equipment *when bought at the same time as the boiler.*

If any one of these 5 conversion boilers is bought at the start for coal, it in turn can at any time easily be converted to oil, at no additional cost.

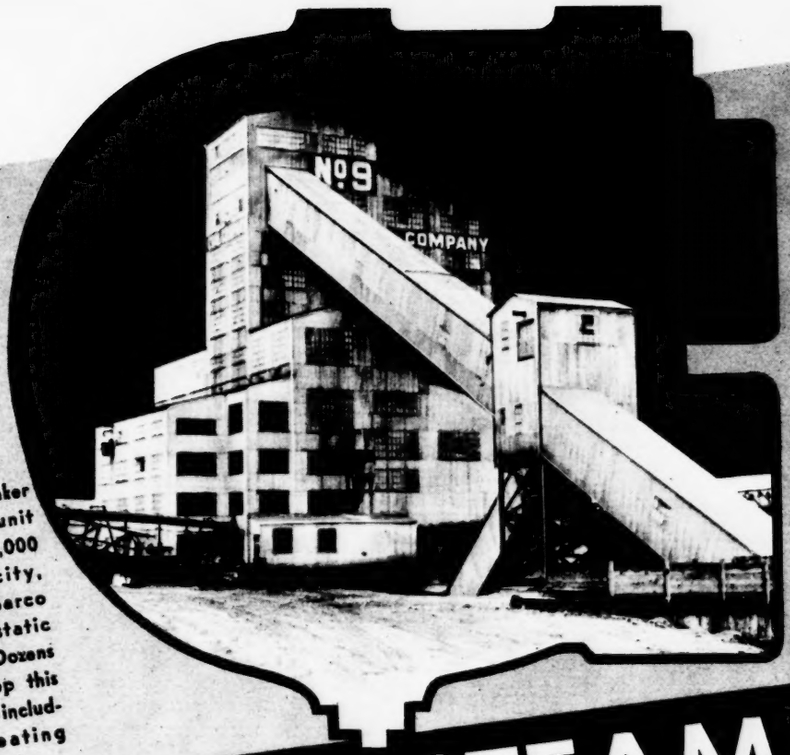
So let Burnham help solve your fuel problem. Send for special printed matter on our 5 Conversion Boilers.

Burnham Boiler Corporation

Irvington, N. Y., *Dept. T* **Zanesville, Ohio,** *Dept. T*

Branch Offices in all Principal Cities

Export Dept.: 50 Church St., New York City



This big coal breaker is heated by unit heaters of 650,000 b.t.u. capacity, drained by Sarco Float-Thermostatic Steam Traps. Dozens of Sarcos keep this plant warm—including track heating lines in the yard.

Specified for the Big Jobs

SARCO STEAM TRAPS

Put yourself in the place of the men who specified the steam traps for the three big jobs illustrated on this page—a coal breaker with a heating problem almost as big as all outdoors; a Chicago apartment requiring converters heating 1900 gallons of water a minute; and a large office building with an air conditioning system for all floors!

You would compare, test, confer and consider because your future would be at stake.

To be secure in your decision you would specify Sarco, just as these engineers did. Not merely because these products were built in the newest, biggest and best plant devoted exclusively to steam traps and control; and not because every Sarco user you talked to said you would make no mistake. It would be because—from every angle—after weeks of consideration you knew that Sarco Steam Traps would substantiate your judgment.

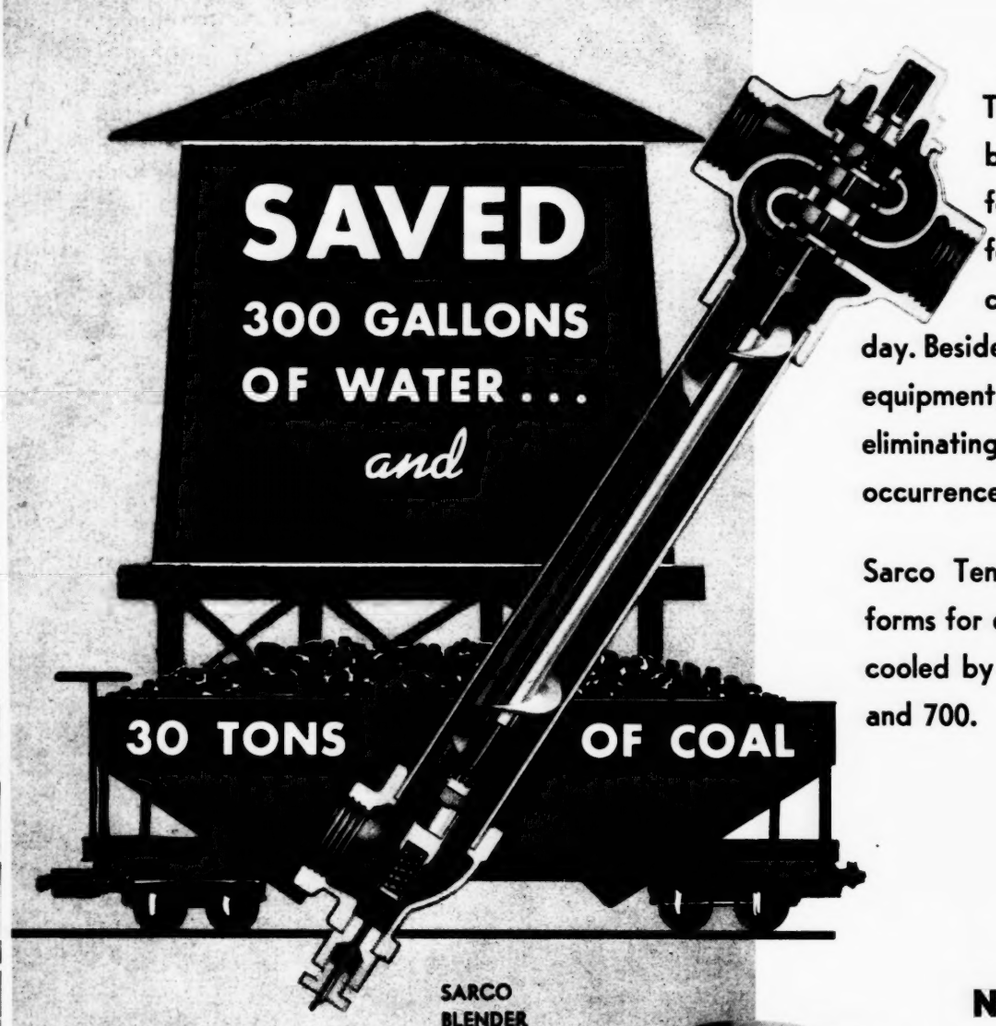
It costs no more to start right—with Sarco. Users say it costs a lot less in the long run. In fairness to yourself, you should include Sarco in your consideration for your next job, or as a replacement for equipment that is not operating satisfactorily now.

Sarco Company, Inc., 475 Fifth Avenue
New York, N. Y.
Sarco Canada, Ltd., Toronto, Ont.

Hundreds of tenants—converters from 900 to 1900 gallons per minute and mammoth hot water storage tanks—all All-Sarco in the largest housing development in Chicago.

If you were the chief engineer of an air conditioning company, what kind of steam traps would you select for your own office and warehouse? Sarco is the answer. There are dozens of them on this one job.

SARCO SAVES STEAM

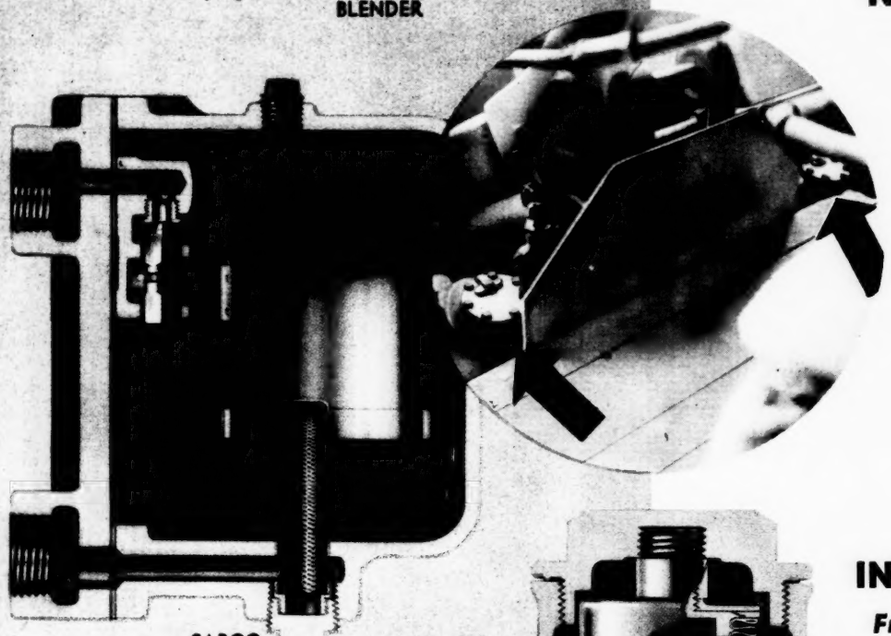


SARCO
BLENDER

This Sarco Blender replaced a stokered boiler. It uses compressor cooling water formerly wasted and provides hot water for showers and heat for a wash room accommodating 200 miners in three shifts a day. Besides saving an investment of $1,050 in boiler equipment, this arrangement gives excellent service, eliminating entirely the complaints that were a daily occurrence before. Catalog No. 800.

Sarco Temperature Control is available in many forms for equipment heated by steam, gas or oil, or cooled by water or brine. Ask for Catalog Nos. 52 and 700.

NOT ONE CENT FOR REPAIRS



SARCO
BUCKET TRAP

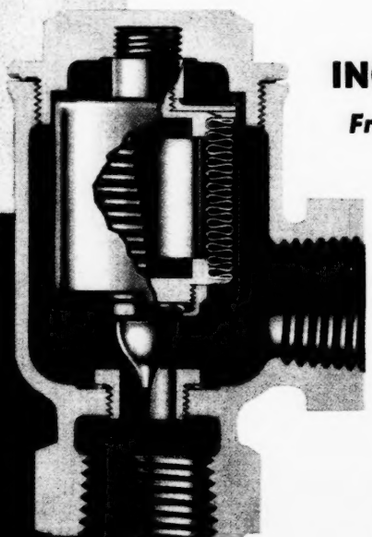
The illustration shows two of fifteen Sarco Bucket Traps on Hoffman equipment at Red Seal Cleaners in Detroit. The traps have functioned perfectly—not one cent for repairs or replacement. You will find Sarcos on all kinds of laundry equipment from soap cookers to washers, ironers and presses.

CUT WATER COST
INCREASED PRODUCTION 10%

From Nebraska this laundry manager writes:

"Sarco No. 9 Traps are lifting condensate 15 feet above the return line with perfect satisfaction. Sarco Control is holding hot water at 170 degrees without variation. The traps save us 3,000 to 5,000 gallons of make-up water a day and our flat work ironer is putting out 10% more work."

ALEX MESTON, JR., Mgr.
IDEAL LAUNDRY



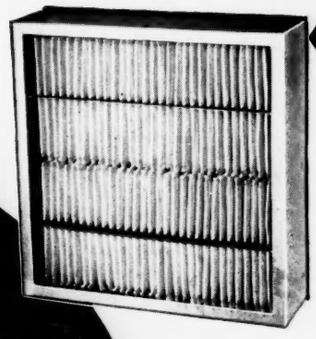
SARCO
THERMOSTATIC TRAP

SARCO
SAVES STEAM

Sarco Canada, Ltd., Toronto, Ont.
Represented in Principal Cities

Staynew AUTOMATIC FILTERS

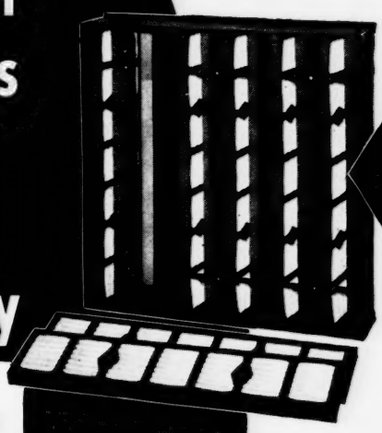
Impingement type. Dust is caught by oil-moistened moving filter panels, automatically timed to operate at pre-determined intervals, depending on amount of dust to be removed and air velocity. A number of unusual features increase efficiency and reduce operating costs. Several features are fundamental in design and exclusive. The result is a rugged, high-efficiency unit with which extremely large volumes of air can be filtered at low cost.



PANEL FILTERS

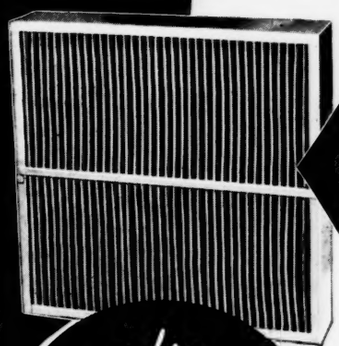
Feature famous Feltex filtering medium, extremely efficient, yet, as used in the Fin Construction, offering minimum restriction. A 20″ x 20″ Panel has a total filtering area of 42 square feet. Resistance at 800 c.f.m., 19 f.p.m. velocity, is only 0.2 W.G. Some of America's finest buildings are Panel Filter-equipped, as is the recently-built G. Fox & Co. department store of Hartford, Conn. This installation has a capacity of over 700,000 c.f.m.

Complete Line of Famous Air Filters READY for Prompt Delivery



MULTI-V-TYPE FILTERS

Lightweight, relatively inexpensive filters of great efficiency and slight resistance to air flow. Multi-V-Type Filters possess greater efficiency than the "discard" type; can be easily cleaned by vacuum or by tapping against a flat surface and will operate for long periods without appreciable increase in resistance.



WIRE-KLAD FILTERS

Low cost, long-lasting. Patented construction (filter medium held between two layers of wire cloth) makes this filter extremely resistant to heat. Wire-Klad filters fulfill the provisions set forth in Section 150 of the National Board of Fire Underwriters Pamphlet No. 90.

ALL SIZES, TYPES AND MODELS IMMEDIATELY AVAILABLE

Many months ago we anticipated the present industrial expansion, adding new manufacturing equipment and buying extra stocks of materials. As a result, WE ARE READY — and you can place an order for any size, quantity or model filter with Staynew in full confidence of prompt shipment.

— also —
FILTERS FOR COMPRESSORS INTERNAL COMBUSTION ENGINES AND PUMPS

Write for Complete Catalog
Including Data Blank for Free Analysis of Your Requirements

STAYNEW FILTER CORP. 15 Leighton Ave., Rochester, N. Y.

PROTECTOMOTOR 95 and 98 Per Cent AIR FILTERS — "Air Filter Headquarters"